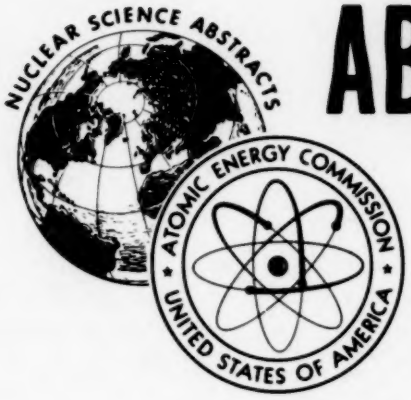
NUCLEAR SCIENCE ABSTRACTS



Volume 30 Number 6

Abstracts 14741-18164

September 30, 1974

UNITED STATES ATOMIC ENERGY COMMISSION

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NOTICE

A title page for Volume 30, Numbers 1–6, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 29, No. 3, Abst. 5020, line 1 should read: (CEA-CONF-2362) GEVATRAN: A COMPUTER

NSA Vol. 29, No. 5, Abst. 10782, line 1 should read: (NP-20084) APPLICATION OF ARTICLE 37 OF THE

NSA Vol. 29, No. 6, Abst. 13912, line 1 should read: (COO-1112-198) IMPACT PARAMETER DESCRIP-

NSA Vol. 29, No. 9, Abst. 23578, line 1 should read: (COO-2244-1A) STEAM-WATER MIXING TEST PRO-

NSA Vol. 29, No. 11, Abst. 28925, line 1 should read: (ORO-3897-5) PROGRAM FOR THE INVESTIGATION

NSA Vol. 29, No. 12, Abst. 30511, line 1 should read: (BNL-18672) ANALYSIS OF THE INTERACTION

Volume 30, Number 6, September 30, 1974

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services
Published by the USAEC Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

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Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SMITH, H., Planetary nebulae: two types, 29:13374
SMITH, H.R. Jr., Principles of electron beam technology, 29:13155
SMITH, J., See HOEGERMAN, S.F., 29:13035
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REACTOR MATERIALS/STRESS ANALYSIS
Problems on nuclear reactor structure at elevated temperature, 29:14654
REACTOR PROTECTION SYSTEMS
HTGR gas turbine power plant control and safety studies. Quarterly progress report for the period July 1, 1973--September 30, 1973, 29:14846 (GULF-GA-A-12799)

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14452 (WASH-1278) CTR ENGINEERING SYSTEMS STUDY REVIEW MEETING, GERMANTOWN, MARYLAND, SEPTEMBER 19 AND 20, 1973. Gough, W. C. **(USAEC Division of Controlled Thermonuclear Research, Washington, D. C.).** 1973. 258p. (CONF-730971-). Dep. NTIS $7.60.

is indexed as:

USAEC DIVISION OF CONTROLLED THERMONUCLEAR RESEARCH, WASHINGTON, D.C.
CTR engineering systems study review meeting, Germantown, Maryland, September 19 and 20, 1973, 29:14452 (WASH-1278)

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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 30, Number 6 September 30, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 16478–16480 and 18088.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 15702 and 15735.

14741 (AREAEE-187) EVALUATION OF THERMAL NEUTRON GAMMA-RAY TECHNIQUES FOR NONDESTRUCTIVE ANALYSIS OF GEOLOGICAL SAMPLES. I. El-Kady, A. A.; Hamouda, I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 26p. Dep. NTIS (US Sales Only) $4.50.

The feasibility of using the measurement of thermal neutron capture gamma-rays as a nondestructive technique for elemental analysis contents of geological samples both in laboratory and in situ is being studied. A survey has been done for the suitable instrumentation (neutron sources, detectors and electronics) that can be used in this study. An experimental set up was constructed and is now being tested. A neutron beam from the 2-MW research reactor will be used as a neutron source for preliminary studies, while an available 5-Ci plutonium–beryllium (Pu–Be) neutron source will be tested for possible in situ measurements. A 30-cm^3 Ge(Li) detector system and a 3 in. × 3 in. sodium iodide detector system, were tested for this work. The characteristic neutron capture gamma lines from the most probable interfering elements in a typical geological sample together with the lines from the elements proposed by the (EGSMA) are listed in a table. Also listed in this table are their corresponding cross-sections and sensitivity indices. From this table the elements Be, Ag, Au, W, Sc, Ce and Pb can be easily identified due to the existence of high intensity lines with corresponding high sensitivity index, while identification of the elements Ta, Nb and Sn are limited to high concentration content due to the absence of high intensity characteristics lines. Neutron capture spectra from some elements are also given. A suggested procedure for the next phase of this project is given. (auth)

14742 (CEA-CONF-2604) DETERMINATION OF LITHIUM GRADIENTS UNDER THE SURFACE OF GLASSES BY DETECTION OF THE PROMPT γ PHOTONS FROM THE ^{7}Li(p,γ)^{8}Be REACTION. Engelmann, C.; Golicheff, I.; Loeuillet, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). 25 Sep 1973. 24p. (In French). (CONF-731078-1). Dep. NTIS (US Sales Only) $4.25.

From international colloquium on new techniques in the study of surfaces; Ghent, Belgium (22 Oct 1973).

The narrow resonance at 441 keV was used for the rapid determination of the Li concentration gradient under the surface of glass samples. The yield curve for the resonance in thin targets was determined with precision in the same manner as the photon emission yield curve of Li in thick targets between 300 and 1500 keV. The intrinsic mass detection limit, in the absence of all interference, of the order of 100 μg/g for a beam with intensity equal to 1 μamp, which corresponds to a surface intrinsic detection limit of 5×10^{-3} μg/cm^2. The thickness resolution is close to 2000 Å in glass and the concentration profiles can be measured up to a depth of about 10 m. The duration of a gradient rise is from 2 to 3 hrs. It was shown that the Li profile undergoes a surface modification when the charge of protons accumulated on the target passes a certain value. (tr-auth)

14743 (COO-3126-26) NUCLEAR AND RADIOCHEMICAL TECHNIQUES IN CHEMICAL ANALYSIS. Progress Report, June 1, 1973–May 31, 1974. Finston, H. L. (Brooklyn Coll., N. Y. (USA). Dept. of Chemistry). 1974. Contract AT(11-1)-3126. 37p. Dep. NTIS $5.00.

Many methods are being employed, which can determine mercury into the nanogram per gram range. However most of these methods require some sample pretreatment (e.g., digestion, ashing, lyophilization or extraction). It is shown that these procedures result in serious loss of mercury, when the concentration of mercury in the original sample is less than 1 μg per gram. This loss is due mainly to adsorption and volatilization of the mercury during the sample pretreatment and can be as much as 70% for environmental samples. Analyses of NBS Standard Reference Materials 1571, 1577 and 1630, yield 0.305 ± 0.013, 0.203 ± 0.013 and 0.486 ± 0.060 μg of Hg per gram of sample, respectively. These values are considerably higher than those reported by the NBS, but are obtained by neutron activation analysis with no sample pretreatment. (auth)

14744 (FEI-370) PROBLEM OF THE CONTROL OF FISSIONABLE MATERIALS IN ACCORDANCE WITH DELAYED NEUTRONS. Maksyutenko, B. P.; Tarasko, M. Z. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 5p. (In Russian). INIS.

In order to identify fissionable materials or to determine their percentage content in a mixture it is proposed that along with the ordinarily used six-group analysis of the delayed neutron decay curve a new method be used that is based on the representation of the decay curve by a continuous distribution of delayed neutron predecessors with regard to the half-lives. (SJR)

14745 (KHFTI-72-45, pp 29-31) GAMMA ACTIVATION ANALYSIS FOR CARBON DETERMINATION IN PURE SUBSTANCES WITH ^{11}C RADIOISOTOPE RELEASE. Gorenko, A. F.; Skakun, N. A.; Zadvornyi, A. S.; Shevchenko, G. M.; Bugaeva, N. I.; Klyucharev, A. P.; Ryabka, P. M. 1972. (In Russian).

A process for the γ activation control of the C concentration with preliminary chemical precipitation of $^{11}CO_2$ by oxidizing fusion and with subsequent measurement of the ^{11}C activity is described. Samples of a Mg–Be alloy were irradiated for 10 min. with bremsstrahlung γ at an energy of 30 MeV with an average electron current of 4.2 μamp at the converter. With these irradiation conditions and with registration of the activity by NaI (Tl) crystals the sensitivity of the C determination was 2.6×10^{-7} g. The method was used for the analysis of the C content in different metals and alloys. (tr-auth)

14746 (KHFTI-72-45, pp 31-32) SOME ADVANTAGES OF USING ELECTRON ACCELERATORS FOR ACTIVATION ANALYSIS OF LIGHT ELEMENT IMPURITIES. Gorenko, A. F.; Zadvornyi, A. S.; Skakun, N. A.; Shevchenko, G. M.; Bugaev, N. I.; Klyucharev, A. P.; Ryabka, P. M. 1972. (In Russian).

The application of gamma activation analysis to the determination of O and C impurities in pure metals is described. The activation of the samples with γ quanta generated by accelerator electrons in converters of heavy elements has a series of advantages. The possibility of surface charging of the samples is eliminated. The conditions for the irradiation of the samples is simplified as the samples do not have to be placed in the vacuum chamber and pneumatic tubes can be used for their transport. γ activation analysis with differing sensitivities in the de-

termination of O and C was applied to B, Be, Na, Mg, Al, V, Mn, Ni, Co, Te, Bi, Tm, Yb, Lu, Tb, and I. (tr-auth)

14747 (SGAE-2257) ROLE OF CERTAIN TRACE ELEMENTS IN THE APPEARANCE OF ARTERIOSCLEROSIS. Karimian-Teherani, D.; Altmann, H.; Hagmueller, G.; Denck, H.; Eberl, R. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Mar 1974. 14p. (In German). (CONF-740453-1). Dep. NTIS (US Sales Only) $4.00.

From 4th international congress of angiology; Florence, Italy (3 Apr 1974).

With the help of neutron activation analysis various elements (Hg, Se, Cr, Au, Br, Co, Zn, and Fe) in the arteriosclerotic vessels of patients were determined. In the comparison of the trace element concentration of the veins and arteries only with Hg was there a significant difference. If the ratio of the trace elements in the vessels of smokers and non-smokers is studied, it was shown that only a significant increase of Se was found in smokers. In comparison of the trace elements found in the blood vessels of healthy persons as reported in the literature the elements Hg, Se, Cr, and Br are increased in patients with arteriosclerosis. (tr-auth)

14748 (STI/PUB-348) COMPARATIVE STUDIES OF FOOD AND ENVIRONMENTAL CONTAMINATION. Proceedings Series. Proceedings of a Symposium Held in Otaniemi, Finland, 27–31 August 1973. (International Atomic Energy Agency, Vienna (Austria)). Mar 1974. 633p. (In English and French). (CONF-730817-). IAEA $27.00.

Separate abstracts were prepared for 34 of the 45 papers presented in these proceedings. Six papers discuss the metabolism and toxicology of chemical residues. Five papers were previously abstracted for NSA and appeared as 28: 17850 and 20610 and 29: 4793, 4794, and 28965. (ERB)

For abstracts of individual papers see: 14761–14771, 15373, 15384, 15433, 15448–15453, 15469–15473, 15539, 15540, 15862, 16063, and 16073–16077.

14749 (TID-26613) DETERMINATION OF TOTAL BODY CALCIUM (SKELETAL MASS) IN MAN BY IN VIVO NEUTRON ACTIVATION ANALYSIS AND TOTAL BODY COUNTING. Project Progress Report, July 1, 1973–June 30, 1974. Nelp, W. B. (Washington Univ., Seattle (USA); Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 20 Mar 1974. Contract AT(45-1)-2225. 47p. Dep. NTIS $5.50.

Bone mass in relation to the therapy of osteoporosis was studied. By collecting ^{37}Ar from exhaled breath following whole-body neutron activation, total body calcium can be determined. Data are available for 33 normal males and females from ages 21 to 80. Instrumentation development is described. (MCG)

14750 MODIFIED APPROACH TO FORENSIC ACTIVATION ANALYSIS OF HAIR. Pillay, K. K. S.; Moss, S. H.; Bricklemyer, M. A.; Jester, W. A. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 18: 62(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14751 MATERIAL BALANCE OF SELECTED ELEMENTS IN CIGARETTE SMOKE. Williamson, T. G. (Univ. of Virginia, Charlottesville); Chiang, A. S.; Jenkins, R. W.; Lester, G. E.; Newman, R. H. Trans. Amer. Nucl. Soc.; 18: 64-65(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14752 PROCESS CONTROL OF COPPER ORE USING NEUTRON GAMMA-RAY ANALYSIS. Sanquist, G. M. (Univ. of Utah, Salt Lake City); Akalin, O.; Rogers, V. C.; Linn, T. A. Jr. Trans. Amer. Nucl. Soc.; 18: 65(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14753 DETERMINATION OF NICKEL BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS IN HAIR AND ITS RELATIONSHIP WITH NICKEL DERMATITIS. Katz, S. A. (Rutgers–The State Univ., Camden, NJ); Samitz, M. H. Trans. Amer. Nucl. Soc.; 18: 66(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14754 NEUTRON ACTIVATION ANALYSIS USING ^{252}Cf SOURCES. John, J. (Intercoim Rad Tech., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 91-92(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14755 SENSITIVITIES IN ^{252}Cf NEUTRON ACTIVATION ANALYSIS. Ricci, E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 92-93(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14756 ^{252}Cf NEUTRON ACTIVATION ANALYSIS AT THE SAVANNAH RIVER LABORATORY. MacMurdo, K. W.; Bowman, W. W. (Savannah River Lab., Aiken, SC). Trans. Amer. Nucl. Soc.; 18: 93-94(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14757 REVIEW OF 14-MeV NEUTRON ACTIVATION ANALYSIS. Wood, D. E. (Kaman Sciences Corp., Colorado Springs, CO). Trans. Amer. Nucl. Soc.; 18: 94(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14758 DEVELOPMENT OF AN IN-VIVO NEUTRON ACTIVATION ANALYSIS FACILITY AT MIT. Murray, B.; Brownell, G. L.; Correia, J.; Harvey, J.; Zamenhof, R. (Massachusetts General Hospital, Boston). Trans. Amer. Nucl. Soc.; 18: 96 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14759 CLINICAL IN VIVO ACTIVATION ANALYSIS MADE SIMPLE. Boddy, K.; Holloway, I.; Elliot, A. (Scottish Universities Research and Reactor Centre, Glasgiow). Trans. Amer. Nucl. Soc.; 18: 96-97(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14760 ARGON-37 EXCRETION IN HUMANS FOLLOWING TOTAL-BODY NEUTRON ACTIVATION. Lewellen, T. K. (Univ. of Washington, Seattle); Nelp, W. B.; Palmer, H. E. Trans. Amer. Nucl. Soc.; 18: 97-98(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14761 TRACE ELEMENT CONCENTRATIONS IN ATMOSPHERIC AEROSOLS AND RAINWATER, MEASURED BY NEUTRON ACTIVATION AND γ-RAY SPECTROMETRY. Bogen, J. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 75-90 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The concentrations of trace elements in particulate matter in the earth's atmosphere allow comparisons of pollution data for various localities to be made. It also makes it possible to estimate the capacity of the atmosphere to take up pollutants. In this work, trace element concentrations in aerosols and rainwater measured for the Heidelberg area are compared. Aerosols were deposited on Microsorban filters, while the residues of rainwater (soluble + insoluble fractions) were obtained by evaporation to dryness. All samples were irradiated using a thermal neutron flux of 3×10^{11} $n \cdot cm^{-2} \cdot s^{-1}$. Gamma spectrometry employing two Ge(Li) detectors of 30 and 40 cm^3 effective volumes and with FWHM resolutions of 3.5 and 5.5 keV allowed of the detection of eighteen trace elements per sample. For aerosols, the concentrations of the elements sodium, chlorine, scandium, chromium, manganese, iron, cobalt, bromine, silver, cadmium, indium, tin, antimony, cesium, lanthanum, cerium, samarium, and mercury are reported and compared to the concentrations found in rainwater. Wash-out factors are calculated from these values for the various elements. By considering the concentrations of the different elements relative to the concentration of sodium in the sample, three groups of elements can be defined whose main sources of the elements are: the ocean (Na, Cl); the earth's surface (Sc, Cr, Mn, Fe, La, Ce, Sm); elements related to man's activities (Co, Br, Ag, Cd, Sn, Sb, Hg). The divisions between these groups are of course not absolute. Looking at the wash-out factors it appears that the ocean-related group is removed from the atmosphere more efficiently than the other two groups. The average trace-element concentrations in aerosols found for the Heidelberg area are compared to values for Paris, Wraymires (UK), and several localities in the USA. The values for the Heidelberg area show that it is relatively unpolluted, comparable with the more rural locations in the UK and USA. For the city of Paris the concentration figures of the elements mercury, chlorine, bromine, antimony, cerium, and mercury are relatively high. For the heavily polluted area of East Chicago the elements showing the highest concentration ratios are chromium, manganese, iron, cerium, and mercury. (auth)

14762 STUDY OF AIR CONTAMINATION IN MEXICO CITY. Navarrete, M. (Centre de Estudios Nucleares, Mexico City);

Galvez, L.; Tzontilmatzin, E.; Ley, A. pp 91-102 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974). (In Spanish).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

In December 1971 a research project aimed at determining the extent of contamination of the air in Mexico City by solid pollutants was started. Samples were taken on grade C-1140 Dexter filter paper with a model 251-223 Curtin sampling pump and submitted to activation analysis in the Triga Mark III reactor of the National Nuclear Energy Institute, which collaborated with the Centre for Nuclear Studies of the National Autonomous University of Mexico in this investigation in the interests of a national program to combat contamination. The purpose was not only to find contaminants which, although present in low concentrations, might be damaging to health, but above all to localize the principal sources of contamination and determine by what mechanisms it is spread. In the present work eleven elements are considered (Al, As, Br, Ca, Cl, Mg, Mn, Hg, K, Na, V). Their concentrations are given in nanograms per cubic metre of air and the results are compared with those obtained in other cities. The authors conclude that in the case of Mexico City a significant source of contamination is to be found in soils containing little or no moisture; these release dust which passes easily into the air, whose relative humidity is also very low. It is thought that one way of alleviating the problem might be to add massive doses of calcium chloride or some other flocculant which can be produced cheaply to the argillaceous soils covering vast areas of the dried lakes—Texcoco, Chalco and Tláhac—near the capital. (auth)

14763 MERCURY POLLUTION OF THE AQUATIC ENVIRONMENT IN FINLAND. Hasanen, E. (Technical Research Centre of Finland, Otaniemi). pp 149-157 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The mercury content of environmental samples has been studied in Finland since the year 1966 using neutron activation analysis. The studies have been carried out in collaboration with a number of research institutes and the Reactor Laboratory. Hitherto nearly 1500 environmental samples have been analyzed. Fish and bottom sediments have formed the larger proportion of the samples studied by this method. The mercury content of fish living in watercourses under natural conditions has normally been between 0.1 to 0.3 ppM (fresh weight). In lakes polluted with industrial waste waters the mercury content of fish has been found to be between 0.5 to 6 ppM. The mercury content of bottom sediments has varied between 0.05 and 600 ppM (dry weight). The results of comparison analyses made using neutron activation analysis, a colorimetric and flameless atomic absorption method are presented. (auth)

14764 TRACE ELEMENT CONCENTRATIONS IN SOME ITALIAN UNDERGROUND WATERS, DETERMINED BY NEUTRON ACTIVATION ANALYSIS. Clemente, G. F. (Commitato Nazionale per l'Energia Nucleare, Rome); Mastinu, G. G.; Santaroni, G. P. pp 213-227 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Thermal neutron activation analysis and a large-volume high-resolution Ge(Li) gamma spectrometer connected on-line to a DEC PDP 8/L computer, were used to measure the concentrations of sodium, scandium, chromium, iron, cobalt, nickel, zinc, arsenic, selenium, bromine, rubidium, silver, antimony, cesium, and mercury in water samples. This paper is a progress report of a survey intended to determine the actual dietary intake of trace elements, with particular reference to their toxicity, by the Italian population. Trace element levels were determined in about forty sub-surface waters owing to the primary importance of the water as a transfer vehicle of these elements from the environment to man through the food chain. The elements measured can be divided into two groups as a function of the sensitivity of the method: (a) Na, Sc, Cr, Fe, Co, Ni, Zn, Br, Rb, Cs, whose concentrations were above the limits of detection in almost all of the water samples measured; and (b) As, Se, Ag, Sb, Hg whose concentrations were below these limits in a large number of water samples. Great variation was observed in the trace-element concentrations between the different water samples. A critical discussion of the data leads to the conclusion that the concentrations of trace elements observed in the water samples represent their natural levels and do not suggest any substantial degree of pollution. (auth)

14765 SELENIUM CONTENT OF SOME FOODSTUFFS AND ENVIRONMENTAL SAMPLES ON AN AREA OF ITALY RICH IN MINERALS. Bomibace, M. A.; Cigna Rossi, L.; Clemente, G. F. (Comitato Nazionale per l'Energia Nucleare, Rome). pp 341-349 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

No data are available on selenium concentrations in the environment in Italy, in spite of its importance as a toxic but essential trace element. In order to get some information about the concentration and distribution of this element in the environment and in the food-chain, a survey has been made in the Amiata Mountain area (Toscana, Italy). The area was selected for this study owing to the many elements in minerals in the locality (e.g. iron, copper, silver, antimony and, particularly, mercury). The selenium contents were determined by thermal neutron activation followed by analysis using a large-volume high-resolution Ge(Li) gamma-ray spectrometer connected on-line to a DEC PDP 8/L computer. The method requires neither a chemical separation technique nor concentration of the selenium at any stage. The selenium concentration (wet weight) in foodstuffs ranged between 0.008 ppM (in milk) and 0.2 ppM (in chicken). The average selenium intake for the population living in the area under investigation has also been estimated. A critical discussion of the data is reported together with a comparison with selenium data for other countries. (auth)

14766 BROMINE CONTENT OF VEGETABLES AND ITS ACCUMULATION AFTER SOIL FUMIGATION WITH METHYL BROMIDE, USING NEUTRON ACTIVATION ANALYSIS. Staerk, H. (Technische Univ., Munich); Suess, A. pp 417-428 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

In order to set up a definite tolerance dose for bromine, intensive analyses of bromine in 20 different species of vegetable plants were carried out. To elaborate the influence of different origins and soil types, the plants were collected from different parts of the Federal Republic of Germany. The natural bromine content in fresh vegetable varied, depending on plant species, from 0.5 to 3.0 ppM. The study of the natural bromine content in different vegetable plants was carried out using a non-destructive neutron activation method that gave good accuracy and high speed, making possible the analysis of a large number of samples. Since only 20 to 100 mg of dry substance is needed, the method can conveniently be used for the study of plant metabolism during the growing season without damaging the plant. After the treatment of soil with methyl bromide, the bromine contents of the vegetables increased by factors of about 200 or more. The bromine uptake is influenced by several parameters: plant species, soil types, methyl bromide dose, vegetation time, and rotation. To study the importance of these factors, two large field experiments were run. The variation of bromine uptake was investigated in several plant species: lettuce, cucumber, tomato, radish, kohlrabi, celery, bean, parsley, and cauliflower. The first trial was started in 1970, a second in 1972. The results obtained from the analysis of about 2000 samples are given and discussed. Plants grown in soil that was fumigated in the previous year showed a considerable reduction in bromine content, but the values were still significantly higher than the natural levels. Investigations were also undertaken on the distribution of bromine in different parts of the plant. Bromine tends to accumulate more in the leaves, while root crops show lower contents. Samples were taken at the different growing stages to investigate the variation of the bromine uptake with time. (auth)

14767 MULTI-ELEMENT CHARACTERIZATION OF ATMOSPHERIC AEROSOLS BY NEUTRON ACTIVATION AND DIRECT γ-RAY ANALYSIS, AND X-RAY FLUORESCENCE ANALYSIS. Rancitelli, L. A.; Cooper, J. A.; Perkins, R. W. (Battelle Pacific Northwest Labs., Richland, WA). pp 431-454 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

A large variety of man's activities as well as natural events contribute to the total inventory of atmospheric aerosols. Many of these sources have unique chemical compositions which can be employed to assess the impact of a specific source to the

total inventory on a local and world-wide basis. The simultaneous measurement of a wide spectrum of elements collected on air filters and in rain water can yield a great deal of information on the origin, transport, and removal of atmospheric pollutants. A pair of highly sensitive, precise and complementary instrumental techniques, x-ray fluorescence and neutron activation analysis, have been developed and employed to measure over 40 elements on air filters and residues from fossil-fuel plants. The x-ray fluorescence analysis is based on the direct excitation of characteristic x-rays of the elements with 100 μCi ^{55}Fe and ^{109}Cd sources and their measurement with Si(Li) x-ray energy analyzers. Quantitative results are obtained both by comparing the air filter results to thin film standards and by using those elements measured by neutron activation as internal standards. The neutron activation procedure involves irradiation of the filter samples together with the appropriate standards followed by a γ-ray analysis of the activation products, after appropriate decay intervals, on either conventional or anticoincidence shielded Ge(Li) gamma-ray spectrometers. Several important observations concerning the origin of elements in urban aerosols can be inferred from the ratio of the trace element concentrations to the scandium concentrations. From a comparison of these ratios in granite and diabase with those of the filter, it is evident that zinc, selenium, antimony, mercury and lead levels have been increased by as much as several orders of magnitude. Aluminium, cobalt, lanthanum, iron, europium, samarium, terbium, tantalum, hafnium and thorium appear to exist at levels compatible with an earth's crust origin. (auth)

14768 REALISTIC DETECTION LIMITS FOR NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL SAMPLES. Spyrou, N. M.; Fricker, M. E.; Robertson, R.; Gilboy, W. B. (Univ. of Surrey, United Kingdom). pp 471-487 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The remarkable sensitivity of neutron activation analysis has led many investigators to apply it to a wide range of problems involving trace elements. The widespread availability of high-resolution semiconductor detectors for gamma spectrometry has encouraged many workers to develop purely instrumental analyses to avoid the necessity of chemical separation. However, in biological samples the presence of bulk elements with appreciable cross-sections gives rise to large interfering backgrounds, with the result that the sensitivities achieved for the elements of interest may be much poorer than the published values, which do not take into account matrix effects. This paper presents experimental detection limits in typical biological media for trace levels of elements of interest in environmental studies, using two types of high-resolution counting systems. (auth)

14769 STANDARD REFERENCE MATERIALS FOR THE DETERMINATION OF TRACE ELEMENTS IN ENVIRONMENTAL SAMPLES. Lafleur, P. D. (National Bureau of Standards, Washington, DC). pp 489-496 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

A concerted effort to determine the quantities and effects of trace elements in the environment requires the application of a number of different analytical techniques in the same or in different laboratories. The interpretation of analytical data is often difficult because of differing results between analysts or even by the same analyst at different times. Standard Reference Materials (SRM), which are certified for their trace element content and are in a matrix similar to the one of interest, can greatly increase the accuracy of analysis and the reproducibility between laboratories. The United States National Bureau of Standards (NBS) has developed a number of SRMs applicable to the determination of trace elements in environmental materials. Two of these, SRM-1571, Orchard Leaves, and SRM-1577, Bovine Liver, are excellent for biological tissue analyses. Several new standards are of value for fossil-fuel analyses. These are: SRM-1632, Trace Elements in Coal; SRM-1633, Trace Elements in Fly Ash; SRM-1634, Trace Elements in Residual Fuel Oil; and SRM-1635, Trace Elements in Gasoline. In cooperation with the US Environmental Protection Agency, the NBS has recently concluded an interlaboratory comparison involving analyses by more than 60 laboratories on these fossil-fuel materials. The results of this intercomparison and the broad range experience with the biological materials will be presented showing both intratechnique and intertechnique variations, and the sensitivities and comparisons with the values certified by NBS. (auth)

14770 QUANTITATIVE ANALYSIS OF FISSILE ELEMENTS IN WATER SAMPLES WITH A SPARK REPLICA COUNTER. Mastinu, G. G. (Comitato Nazionale per l'Energia Nucleare, Rome). pp 497-502 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Counting damage tracks of fission fragments in insulators have found a variety of applications for the quantitative analysis of fissile elements in biological systems and environmental samples. Because the track densities obtained depend linearly on the neutron dose used to induce (n,f)-reactions, high fluxes allow of the detection of extremely small quantities of fissionable materials. If thin insulators are used the damage tracks produce holes that can be easily counted by the spark replica counter. This paper deals with the applications of this new, simple, and sensitive method for the analysis of fissile elements in water samples evaporated onto insulating films. Data are presented on the minimum detectable quantities of fissionable materials in water samples, the necessary neutron fluences and the relative volumes of water evaporated. (auth)

14771 TRACE ELEMENTS IN HUMAN THYROID, WITH SPECIAL REFERENCE TO THE OBSERVED ACCUMULATION OF MERCURY FOLLOWING LONG-TERM EXPOSURE. Kosta, L.; Zelenko, V.; Ravnik, V.; Levstek, M.; Dermelj, M.; Byrne, A. R. (Univ. of Ljubljana, Yugoslavia). pp 541-550 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Attention has recently been drawn to the interactions between trace elements in biological systems, which can considerably modify or even reverse their biological pathways and toxicological behavior. Since concentrations of mercury exceeding 50 ppM of fresh tissue have been found in a few instances in thyroids and pituitary glands of deceased people after long exposures to mercury, a possible interaction with iodine was assumed and comparative measurements were made. Results on autopsy material of several people representative of the population of a mining area are also presented; although the concentrations are much lower, the thyroid and pituitary glands were again found to be the two organs with the highest mercury levels. In persons with no known exposure to mercury, the thyroid does not show evidence of an exceptional behavior. The study was extended to cover several other elements, and activation analysis methods were developed to give simultaneous determinations of copper, zinc, arsenic, iodine, and mercury in small samples of thyroid tissue of operated patients. Analysis of separated thyroidal follicles was also attempted. Results are presented, together with a discussion of contamination problems associated with the sampling and pretreatment of the tissue. They confirm the importance of parallel accurate data on several elements, in particular those for which chemical interactions are to be expected. (auth)

14772 SPRAVOCHYNE TABLITSY DLYA NEITRONO-AKTIVATSIONNOGO ANALIZA. (Reference Tables for Neutron Activation Analysis). Mednis, I. V. Riga; Izdatel'stvo Zinatne (1974). 412p.

Nuclear physics constants, necessary for the solution of problems in neutron activation analysis – identification of elements and calculation of the value of the induced activity – were compiled from data published in the literature through 1972. (tr-auth)

14773 EFFECT OF THE ENERGY DISTRIBUTION OF CHARGED PARTICLES IN ACTIVATION ANALYSIS. Muminov, V. A.; Mukhamedov, S.; Khaidarov, R. A. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 79-81(1974). (In Russian).

A simple formula is proposed for calculating the energy dispersion of charged particles. Values of the dispersion calculated by means of this formula agree well with experimental data. The effect of energy dispersion in activation analysis with charged particles is investigated. (SJR)

14774 SIMULTANEOUS DETERMINATION OF SILICON AND ALUMINUM IN FERROSILICON BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS WITH THE AID OF AN ^{227}Ac–Be ISOTOPIC NEUTRON SOURCE. Alaerts, L.; Op de Beeck, J. P.; Hoste, J. (State Univ., Ghent). Anal. Chim. Acta; 70: 253-263 (1973).

A method was developed for the accurate determination of silicon and aluminium by instrumental neutron activation analysis with

the aid of an $^{227}Ac-Be$ isotopic neutron source. The samples are pellets made of 4.6 g of ferrosilicon and 0.9 g of a pelletizing agent. Each pellet is irradiated twice at two different fast-to-thermal neutron flux ratios. Each irradiation is followed by two integral mode countings. This allows correction for manganese activities and calculation of the fraction of the aluminium activity induced in silicon and aluminium. The method has been tested with laboratory-prepared synthetic samples as well as commercially certified ferrosilicon. For ferrosilicon containing 75% Si, a relative precision of 0.7% for the results of the silicon concentration has been obtained. For aluminium the relative precision varied from 2 to 7% for concentrations of 3.5 to 1.5%. (auth)

14775 DETERMINATION OF CADMIUM, BORON, AND INDIUM IN AQUEOUS SOLUTIONS BY MEANS OF NEUTRON ABSORPTION. Heilwig, K. D. (Marquart (L. C.) GmbH, Bonn). Z. Anal. Chem.; 268: No. 5, 343-347(Mar 1974). (In German).

Cadmium, boron, and indium have high cross-sections different from other elements. Therefore, they absorb slow neutrons strongly. Taking advantage of this property, it is possible to determine those elements rapidly and selectively. The arrangement consists of four parts, neutron source ($^{241}Am-Be$), moderator, cell for the aqueous solutions, and BF_3-neutron counter. This method is suitable for the analytical laboratory and especially for continuous process control. The apparatus with the shielding is described in detail. Furthermore, the problems of statistical error and detection limit are discussed. (GE)

14776 MULTIELEMENT NEUTRON ACTIVATION ANALYSIS OF HUMAN HAIR SAMPLES. Application of the Low Temperature Ashing and HAP Treatment. Huang, C. W. (Tokyo Univ.); Hamaguchi, H.; Higuchi, H. Jap. Anal.; 22: No. 12, 1586-1591 (Dec 1973). (In Japanese).

Neutron activation analysis was applied to determine 17 trace elements in human head hair. After neutron irradiation, hair samples emit intense gamma rays of ^{24}Na and ^{82}Br induced from sodium and bromine contained in the sample. Therefore, in the conventional nondestructive activation analysis, it is not possible to determine accurately the contents of elements that produce short-lived nuclides, because of the interference with the Compton background and photopeaks from ^{24}Na and ^{82}Br. In this study, low-temperature ashing technique was employed, and it was effective for the removal of bromine from the sample. The ashing was carried out for 15 hours at a high-frequency output power of 150 W and an oxygen flow rate of 80 ml/min. The ash was irradiated for 3 days (6 hours/day) in TRIGA Mark II Reactor of Rikkyo University with a neutron flux of 5×10^{11} neutrons per square centimeter per second. After the irradiation, the sample was dissolved in hydrochloric acid. The induced ^{24}Na activity was completely removed by passing the solution through a HAP (hydrated antimony pentoxide) column. Seventeen trace elements, Ag, As, Au, Cd, Co, Cu, Fe, Ga, Hg, In, La, Mn, Ni, Sb, Se, Sr, and Zn, were determined. Time required for the determination was reduced from 42 days to 11 days as compared to the non-destructive activation analysis reported by Perkons and Jervis [Proc. Modern Trend in Activation Analysis, Texas, p. 295 (1965)]. Ashing test of filter paper impregnated with 17 elements shows all the elements except bromine and mercury can be quantitatively recovered. (auth)

14777 ANALYSIS OF ELEMENTAL COMPOSITION BY NEUTRON CAPTURE GAMMA RAYS. Bondarenko, V. A.; Tsirkunova, I. F.; Nétburg, L. A. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 7-11(1974). (In Russian).

Analysis of the elemental composition of ferrites was performed using neutron capture gamma spectroscopy. It was shown that sample location near the reactor core can give two orders higher counting rate than the neutron beam extraction geometry. The sensitivity of the internal target arrangement was found equal to 10^{-3} mole barn per one day run. The method is preferable for determining some light elements and also for some others having a large neutron capture cross-section. (auth)

14778 ANALYSIS OF APOLLO 15 RAKE SAMPLE WALNUTS AND LUNAR BRECCIAS 15465,3 AND 15565,7 FOR MAJOR AND TRACE ELEMENTS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY AND NEUTRON ACTIVATION ANALYSIS. Blanchard, D. P. Madison, WI; University of Wisconsin (1973). 124p. University Microfilms Order No. 743.

Thesis (Ph.D.)

The detailed procedure for the analysis for major elements by instrumental neutron activation and atomic absorption spectrophotometry for 10-mg samples of silicate rock is described. A simple and fast method for detecting chemical interferences in atomic absorption spectrophotometry is detailed. The results of interelement interference tests are reported for Si, Al, Fe, Mg, Ca, K, Na, and Ti for two dissolution schemes, one using $LiBO_2$ fusion and the other using $HF-B(OH)_3$ dissolution. The $LiBO_2$ fusion technique was unacceptable. The $HF-B(OH)_3$ dissolution system was free of chemical interferences for all analytes except Ti whose sensitivity was slightly dependent on Al and Fe concentrations. The averages of multiple analyses of 10-mg aliquots of U.S.G.S. standard rocks were accurate to within 1% (relative) for all elements except Ca (1.5%) and Ti (5%). One σ relative uncertainty for a single analysis was estimated from the observed precision at ±2% for Si, Al, Fe, Ca, K, and Na; ±3% for Mg; and ±5% for Ti. The chemical separation schemes used for analyses of trace elements by radiochemical neutron activation analysis are described briefly. U.S.G.S. standard basalt BCR-1 was analyzed by radiochemical neutron activation analysis for Zn, Cr, Ga, Co, Sc, Hf, Cs, Rb, and 12 rare-earth elements. Determined concentrations compare well with published values. Portions of fourteen Apollo 15 rare sample walnuts were analyzed for the major elements Si, Al, Fe, Mg, Ca, K, Na, Ti, and Mn. One had a composition similar to KREEP basalt. The others were mare basalts. The Apollo 15 mare basalts have higher concentrations of FeO and lower concentrations of TiO_2 than Apollo 11 and 12 mare basalts. The Apollo 15 basalts divide into quartz normative and olivine normative groups. The quartz normative group has higher SiO_2 and lower TiO_2 concentrations than the olivine normative group. The two groups cannot be simply related by olivine or pigeonite crystal fractionation. Three samples each from two Apollo 15 breccias were analyzed for major elements and Ba, Sr, Ni, Zn, Cr, Ga, Co, Sc, Hf, Cs, Rb, and 12 rare-earths. Breccia 15465,3 has a light gray matrix, dark vesicular glass, and predominantly light clasts. The matrix and glass are enriched in KREEP component. A prominent white clast is low alkali, high alumina basalt. The high proportion of highland type material in 15465,3 suggests an origin in a highland formation but not necessarily the Hadley Delta formation on which it was found Apollo 15 breccia 15565,7 has a light gray matrix and large light and dark clasts. The matrix is enriched in KREEP component. The largest dark clast is KREEP basalt. A prominent light clast is an Apollo 15 quartz normative mare basalt. The matrix may be a mixture of primarily KREEP and Apollo 15 quartz normative mare basalt. This evidence suggests that this breccia was formed in the mare regions of the Apollo 15 site or some region with very similar chemical composition. (Diss. Abstr. Int. B)

14779 DETERMINATION OF FLUORINE BY CYCLIC ACTIVATION ANALYSIS METHOD USING $^{241}Am-Be$ NEUTRON SOURCE. Maki, Y. (Industrial Research Inst. of Kahagawa Prefecture, Yokohama, Japan); Norjiri, T.; Masilungan, B. A. Radioisotopes (Tokyo); 23: No. 3, 149-154(Mar 1974).

Cyclic activation analysis using a $^{241}Am-Be$ neutron source was studied to determine the fluorine content. In order to effectively accumulate the counting value of the induced nuclide, the time for neutron burst, for counting and for sample transport considering the half-life of induced nuclide were discussed. See-saw type and pneumatic tube type cyclic activation analysis systems were devised to accumulate the activity of ^{19}N produced by (n,α) reaction. Applying the result, the fluorine content of several kinds of fluorine plastics containing various kind of fillers was determined. The result obtained by cyclic activation method agreed with that by chemical analysis. (auth)

14780 ISOTOPIC TRACER METHOD AND MICROLOCALIZATION OF LITHIUM. Stelz, T.; Hartmann, A.; Thellier, M. (Univ. Rouen, Mont-Saint-Aignan, France). Compt. Rend., Ser. D; 278: No. 7, 955-958(11 Feb 1974). (In French).

The use of $^6Li(n,\alpha)^3H$ nuclear reactions in conjunction with Kodak LR 115 cellulose nitrate detectors enables the stable ^6Li isotope to be utilized as a tracer. A good sensitivity is obtained. The microlocalization of lithium in a preparation can be envisaged with this method. (FR)

14781 CHEMICAL ANALYSIS INVOLVING RADIOACTIVITY AND RADIATION. Saito, N. (Tokyo Univ.); Koyama, M.; Suzuki, N.; Kudo, K.; Morikawa, N. Jap. Anal.; 22: No. 13, (Dec 1973). (In Japanese).

Techniques or otherwise research works in recent years are reviewed for the fields listed, with full references to the reports, papers, etc., and some introductory remarks also given: (1) radiochemical separations of isotopes; (2) isotope dilution analyses for inorganic substances; (3) isotope dilution analyses for organic substances; (4) activation analyses; (5) analyses by track measurement; (6) analyses with sealed radiation source; (7) analyses utilizing Rutherford scattering; and (8) Moessbauer spectroscopy. For (1), the cases of medical-use RIs are also given. In (2), emphasis is currently on substoichiometry, while the dilution method is rather classical. In (4), with popularization of the Ge(Li) detector and a computer in nondestructive multi-element

analyses, the method is used in many research fields. Those of analytical-chemistry interest are mainly given. For (5), the instances of analytical application are mainly mentioned. (6) Deals with the nondestructive testings. For (8), those works of analytical-chemistry interest or its possibility are explained. (JA)

14782 EFFECT OF ERROR ON HALF-LIFE DATA ON THE ACCURACY OF ACTIVATION ANALYSIS. Bereznai, T.; Keomley, G. (Technical Univ., Budapest). Radiochem. Radioanal. Lett.; 17: No. 5-6, 305-312(30 Jun 1974).

The contribution of saturation, decay, and measuring corrections to the final error of activation analysis has been examined. (auth)

14783 DETERMINATION OF BORON IN STEELS BY MEASUREMENT OF THE ALPHA-PARTICLES EMITTED DURING CHARGED-PARTICLE IRRADIATION. Olivier, C.; Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). Radiochem. Radioanal. Lett.; 17: No. 5-6, 335-342(30 Jun 1974).

Measurement of α particles emitted from boron by the reaction $^{11}B(p,\alpha)^{8}Be$ has been used to determine the boron content of steel samples over the range 1 to 100 ppM. By use of particle spectrometry, the intact sample was analyzed without the need for chemical processing. (auth)

14784 MERCURY-197 RETENTION IN DOPED FISH PROTEIN. deJong, I. G.; Wiles, D. R. (Carleton Univ., Ottawa). Radiochem. Radioanal. Lett.; 17: No. 5-6, 343-349(30 Jun 1974).

The retention of ^{197}Hg as CH_3Hg was studied in a matrix of fish protein. A method of doping the protein was developed and shown to be satisfactory. Retention measured in doped codfish protein concentrate is found to be 6.4 ± 0.2%. It is strongly influenced by the presence of methylating agents, which may be eliminated by preliminary isopropanol extraction. This retention may be used for direct quantitative activation analysis for methylmercury. (auth)

14785 ACTIVATION ANALYSIS OF HEAT-RESISTANT NICKEL-BASE ALLOYS. Yagi, M. (Tohoku Univ., Sendai); Nomura, K.; Yamadera, R. Kakuriken Kenkyu Hokoku; 5: No. 2, 161-164(Dec 1972). (In Japanese).

Analysis of Inconels was performed using photonuclear reactions. Inconel C, D, E, F, G, H and I were analyzed as unknown samples using Inconel X 750A as a standard sample. A piece of these unknown samples was wrapped with aluminum foil and sandwiched by standard samples, and irradiated by electron-bremsstrahlung of 30 MeV and 20 MeV for 2 hr. γ-ray spectra were measured using Ge(Li) semiconductor detector and 4096 cPHA (Toshiba). When 30-MeV radiation was used low reproducibility in analytical values resulted caused by disturbing reactions such as $^{56}Fe(\gamma,pn)^{54}Mn$ for Mn and high background noise by high-energy γ-rays from ^{56}Co formed by the reaction $^{58}Ni(\gamma,pn)^{56}Co$. By using 20-MeV radiation these problems were removed. Obtained analytical values are in good agreement with planned composition values and as follows for (Mn, Co, Ti, and Nb), respectively: Inconel C (0.11, 0.04, 2.48, 0.96); D (0.07, 0.04, 2.74, 0.93); E (0.12, 0.04, 2.44, 0.93); F (0.03, 0.05, 2.42, 0.92); G (0.53, 0.08, 2.35, 0.46); H (0.66, 0.11, 2.67, 0.51); I (0.25, 0.18, 0.29, -). (JA)

14786 SOME PRACTICAL ADVANTAGES OF SEALED TUBE 14-MeV NEUTRON GENERATORS FOR TOTAL-BODY IN-VIVO ACTIVATION ANALYSIS. Boddy, K.; Holloway, I.; Elliott, A. (Scottish Research Reactor Center, East Kilbride, Eng.). Phys. Med. Biol.; 19: No. 3, 379-381(May 1974).

Brief note was made of the practical advantages of using two sealed tube 14-MeV neutron generators with a scanning geometry in conjunction with a shadow-shield whole-body counter for total body in vivo activation analysis. Using 14-MeV neutrons body nitrogen and phosphorus could be measured at the same time as calcium, sodium and chlorine. Reproducibility of results with 14-MeV neutrons was as good as that obtained with radioactive neutron sources. It is claimed that the Philips type 18602 neutron generators have a constant neutron output over the tube lifetime and their compactness simplifies construction. The economic advantages are pointed out, with particular reference to the possibility of using two generators to produce a simultaneous bilateral irradiation. (UK)

14787 ACTIVATION ANALYSIS OF CHALCOPHILE ELEMENTS IN NATURAL WATER. Akaiwa, H. (Gunma Univ., Kiryu, Japan). Bunseki Kiki; 11: No. 12, 819-826(Dec 1973). (In Japanese).

Chalcophile elements in natural water were analyzed by neutron activation analysis, and in addition, the extent of chalcophile elements which can be quantitatively analyzed was studied by γ spectrometry using a solid state detector. Nuclides produced by irradiated Cu, Zn, Ga, As, Se, Ag, Cd, In, Sb, Te, and Hg, their half-life periods, and sensitivity of the analysis were shown. The quantitative limit of these elements was stated in 100 ml of natural water. The separation and concentration of the specified elements is effective for the preliminary concentration before activation analysis and the elimination of the radioactivities except chalophile elements after activation analysis. ^{24}Na can be decreased by absorbing with hydrous antimony pentoxide. Chalcophile elements can can be taken as a deposit of sulfide, but it is not quantitative. As for the elimination of V and Th, this method is not sufficient. Chalcophile elements can be selectively concentrated in extraction of solvent by chelate agent of S composition. V and Th were not extracted by diphenyl thiocarbozone. In the extraction of diphenyl thiocarbozone-carbon tetrachloride system, collection rate of Cu, Zn, Co, Ni, Hg, and Cd was about 90%. The probability of the concentration of chalcophile elements due to chelate resin was expressed. In the quantitative examples of chalcophile elements in natural water, the sample water was concentrated at 70°C. After activation analysis, chalcophile elements were extracted in diphenyl thiocarbazone-carbon tetrachloride. Gamma spectrometry was done and Cu, Zn, Ag, Cd, In, Te, and Hg were determined. Although Ga, Se, As in water may be extracted into diethyl ether and measured by gamma-ray spectroscopy, the method for these elements has not been established. (JA)

14788 RESULTS WITH THE FISSION-TRACK METHOD FOR DETERMINATION OF URANIUM IN SOIL SAMPLES. Wiechen, A. (Institut fuer Physik, Kiel). Radiochem. Radioanal. Lett.; 17: No. 5-6, 389-392(30 Jul 1974). (In German).

A very simple analytical technique is presented for the determination of uranium in soil samples using the fission-track method. The technique was checked in 1971 within a comparison program performed by the IAEA in Vienna, and the results were published in 1973. As to the accuracy of the results, the fission-track technique has been found to be at least equivalent to all other methods. The advantage of this method is due to the limited apparatus requirements, and to the possibility of performing simultaneously a great number of analyses, so that the costs of the single analyses become very low. (auth)

14789 DETERMINATION OF CARBON IN SILICON THROUGH PHOTON ACTIVATION ANALYSIS PERFORMED WITH A BETATRON. Helbig, W.; Krogner, K.; Boettger, M. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 10: No. 3, 107-109(Mar 1974). (In German).

The determination of carbon in silicon on the basis of the reaction $^{12}C(\gamma,n)^{11}C$ performed with the aid of the bremsstrahlung of the 27.5-MeV-betatron of the Friedrich-Schiller-University of Jena is a reliable measuring method up to a detection limit about 5 ppM. It serves as a reference method used for the determination through deuterons with the Rossendorf cyclotron. Contents larger than 20 ppm may be measured the non-destructive way. The detection limit of photon activation analysis may be improved with the aid of larger electron accelerators only. (auth)

14790 POSSIBILITIES OF BETATRON IRRADIATION FOR PHOTON ACTIVATION ANALYSIS. Helbig, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Schmalz, L.; Krogner, K.; Niese, S. Isotopenpraxis; 10: No. 3, 109-114(Mar 1974). (In German).

The present status of photon activation analysis is outlined, and the irradiation principles are given. Typical irradiation conditions are described. Detection limits for carbon, nitrogen, and oxygen are discussed. The activity distribution of the ^{11}C in polyethylene foil packets was determined as a function of sample length and thickness. The photon flux from the betatron was evaluated. (JSR)

14791 URANIUM FISSION TRACKS IN GLASSES: CALIBRATION OF PARAMETERS CONCERNED WITH THE REVEALING OF TRACKS AND THEIR RELATION WITH URANIUM CONTENTS. Selo, M. (Univ., Paris); Storzer, D. Compt. Rend., Ser. D; 278: No. 1, 5-8(2 Jan 1974). (In French).

An attempt was made to establish a relation between the chemical composition of glasses and the efficiency with which tracks can be revealed (fixed etching conditions) in order to convert track densities into uranium content. Glasses ranging from tektites, impactites, and obsidians to artificial glasses were studied. This relation can be used to determine uranium in glasses. An error of between 5 and 20% occurs. This method eliminated all errors originating from external contamination and allowed very small U contents to be measured. (FR)

14792 DETERMINATION OF TRACE ELEMENTS IN BLOOD CELLS BY NEUTRON ACTIVATION ANALYSIS. Miki, M. (Kyoto Univ.). Nippon Ketsueki Gakkai Zasshi; 36: No. 6, 883-892(Dec 1973). (In Japanese).

It is necessary to determine the trace elements in small amounts

of white blood cells with a highly sensitive method, because there are some difficulties in collecting sufficient amounts of white blood cells from a patient for chemical analysis. For these reasons, neutron activation analysis was used. About 10 ml of blood samples were withdrawn with heparinized needle and syringe. Blood cells were separated by the dextran sedimentation method. Apparatuses were rinsed three times with HCl, distilled water, double-distilled water, and de-ionized water, and contamination was avoided as much as possible. Samples and standards were irradiated in Kyoto University Reactor, at a flux of 5×10^{12} n/cm^2 sec for 1–2 hours. Tissue samples have too strong ^{24}Na activity after irradiation. Ion-exchange resin method was used for elimination of ^{24}Na and for separation of trace elements. Mn, Cu, and Zn contents in blood cells of various diseases were determined. 10^9 leucocytes of normal man contained Mn, $1.82 \pm 0.65 \times 10^{-2}$ microgram, Cu, $11.0 \pm 3.4 \times 10^{-2}$ microgram, Zn, 128.0 ± 10^{-1} microgram. 10^9 erythrocytes of normal man contained Mn, $1.41 \pm 0.20 \times 10^{-3}$ microgram, Cu, $12.3 \pm 2.6 \times 10^{-2}$ microgram, Zn, $13.0 \pm 3.4 \times 10^{-1}$ microgram. Leucocytes of acute leukemics contained lower value of Mn, Cu, and Zn, especially in myelogenous leukemia. Erythrocytes of acute leukemics showed tendency of high value of Mn, and Zn content, twice as much as normal man. This suggests the abnormal Zn metabolism in the erythrocytes of leukemics. In chronic myelogenous leukemia leukocytes showed tendency of lower value of Mn and Cu and extremely low value of Zn and in the course of one patient the lower value was observed in exacerbation period. Erythrocytes of chronic leukemics showed tendency of low value of Mn and Cu, but tendency of higher value of Zn. Other various diseases; leucocytes of liver diseases showed tendency of low value of Mn, higher of Cu, and lower of Zn; erythrocytes of polycythemia contained higher value of Mn and Zn, and erythrocytes of liver diseases contained lower value of Mn, and higher value of Cu, and in liver cancer contained high value of Zn. (auth)

14793 IN VIVO ACTIVATION ANALYSIS. Ackers, J. G. (Stichting Reactor Centrum Nederland, The Hague). Atoomenerg. Haar Toepass.; 16: No. 4, 87-91(Apr 1974). (In Dutch).

A method of direct determination of the quantity of radioactive nitrogen, calcium, chlorine, potassium, sodium, sulfur, magnesium, manganese, copper, and iodine present in the living human body, after exposure (accidental or occupational) to neutron radiation, or other activating sources, is described. A sensitive γ spectrometer is used; this will lead to further opportunities for medical research. (NL)

14794 FAST METHOD FOR NITROGEN DETERMINATION IN SINGLE SEEDS. Sundqvist, B. (Tandemacceleratorlaboratoriet, Uppsala); Goenczi, L.; Bergman, R.; Lindh, U. Int. J. Appl. Radiat. Isotop.; 25: No. 6, 277-281(Jun 1974).

The (d,p) and (d,α) reactions in ^{14}N were used for probing single kernels of seed for nitrogen content. Due to the large positive Q-values of those reactions in ^{14}N compared to the corresponding reactions in ^{16}O and ^{12}C, it was possible to make reliable and fast determination of nitrogen content in the volume probed by the incident 6-MeV deuterons. Single kernels of wheat and barley from Kjeldahl analyzed samples were studied with the present method and strong correlation was found between the two determinations of nitrogen content. The possibility of achieving depth distributions was also demonstrated. (auth)

14795 DETERMINATION OF MOLYBDENUM IN PLANTS BY NEUTRON ACTIVATION ANALYSIS. Kyun'ke, L. M.; Dubinskaya, N. A. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 12-17(1974). (In Russian).

A possibility of using a nondestructive neutron activation analysis, as well as the radiochemical separation of Mo in plants, has been studied. The sensitivity and accuracy of the analysis associated with the chemical composition of the material and the method used are discussed. (auth)

14796 APPLICATION OF ACTIVATION ANALYSIS TO THE FIELD OF CRUDE DRUGS. Mori, I.; Shinoki, M. (Kobe Women's Coll. of Pharmacy, Japan). Bunseki Kiki; 11: No. 9, 584-590(Sep 1973). (In Japanese).

Principles, experimental procedures, and hints of the absolute method (flux monitor method) for activation analysis of plants of crude drugs by nuclear reactor thermal neutrons are described with the introduction of applied cases. A computer was used for processing and analysis of measurement data. It is necessary to prevent contamination and loss on preparing samples. The time of irradiation and that of cooling are established so that the ratio of target nuclide to secondary nuclide (SN ratio) may be large. Filter papers and millipore filter papers are soaked in a fixed amount of aqueous solution for use as standard samples. The geometric configuration of specimens should be the same as that of the standard sample on irradiation and measurement. Specimens liable to produce contamination during irradiation due to volatilization of elements (Br, Hg, etc.) should be included in a quartz tube. For activation analysis of the Japanese hemp, aqueous solutions of Mn and Co were used as the standard sample. Gamma spectra obtained by measuring short-life nuclides after irradiating the upper part of a leaf of hemp for one minute, followed by cooling for 3 minutes, and by measuring long half-life nuclides after irradiation for one minute, followed by cooling for 7.7 days are presented. Twenty-two elements including ^{24}Na, ^{42}K, ^{47}Ca, ^{49}Ca, ^{38}Cl were determined quantitatively. (JA)

14797 PETROGRAPHIC AND TRACE-ELEMENT DISTRIBUTION STUDIES ON THE DOLOMITE-CALCITE IN THE REGIONAL METAMORPHIC MARBLE OF THE GRIESSCHARTE, TYROL, AUSTRIA/ITALY. Moeller, P. (Hahn-Meitner-Institut, Berlin); Parekh, P. P.; Morteani, G. Chem. Geol.; 13: No. 2, 81-96(Jun 1974).

Petrographic investigations on the light yellow marble outcrops in Griesscharte, Tyrol, Austria/Italy revealed them to be dolomite. The white to blue-grey veins in these marbles were those of calcite. Inside these calcites and along the calcite-dolomite phase boundaries minute and microscopically unidentifiable crystallites (≤ 10 μ) were observed. These crystallites were recognized by x-ray diffractometry as dolomite and their form and distribution were established by scanning electron microscopy. Trace-element distributions on the calcite-dolomite neighbors were studied by neutron-activation method to elucidate the formation mechanism of these calcites in the marble. (auth)

14798 NEW TRENDS IN ACTIVATION ANALYSIS. Rakovic, M. (Inst. of Biophysics, Prague). Radioisotopy; 15: No. 1, 87-98(1974). (In Czech).

The present state of research and applications of activation analysis to the determination of elements is reported. After a short introduction, dealing with the principles and advantages of the method, the various activation methods, chemical separations, counting techniques, and data evaluation methods are described. New trends and potentialities of this method, especially for the determination of trace elements, are indicated; its advantages are emphasized. (auth)

14799 INSTRUMENTAL NEUTRON-ACTIVATION ANALYSIS OF HIGH-PURITY ALUMINUM AND IRON. Mamuro, T.; Mizohata, A. (Radiation Centre Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 23-29(1972).

Aluminum samples were irradiated for 1 hr in a pneumatic-tube facility providing $\simeq 2 \times 10^{13}$ thermal, $\simeq 6 \times 10^{11}$ resonance and $\simeq 3 \times 10^{12}$ fast neutrons per sq cm per sec., or for 70 hr in a graphite thermal column providing $\simeq 9 \times 10^{10}$ thermal and $\simeq 1.6 \times 10^{8}$ resonance neutrons per sq cm per sec. After decay periods of 3 and 10 days (for each type of irradiation), activities were measured with a Ge(Li) detector and a multi-channel pulse-height analyzer. Iron samples were irradiated (i) for 5 min and (ii) for 1 hr in the pneumatic-tube facility, and (iii) for 2 hr in a deuteron thermal column providing $\simeq 1.3 \times 10^{11}$ thermal and $\simeq 4.8 \times 10^{6}$ resonance neutrons per sq cm per sec; activity measurements were made after decay periods of 5 min, 1 hr, and 2 hr, respectively. Results obtained for 19 trace elements in aluminum and for Al, V, Cu, Cr, and Co in iron are tabulated. Serious interference by ^{24}Na [produced by the reaction ^{27}Al(n,α)^{24}Na] in the analysis of aluminum and slight interference by ^{56}Mn [produced by the reaction ^{56}Fe(n,p)^{56}Mn] and by the production of ^{51}Cr from ^{54}Fe in the analysis of iron are discussed. (Anal. Abstr.)

14800 SIMULTANEOUS DETERMINATION OF MERCURY, BROMINE, ARSENIC, AND CADMIUM IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Lee, C.; Kim, N. B.; Park, E. B. J. Korean Nucl. Soc.; 5: No. 4, 265-285(1973). (In Korean).

A method for the simultaneous determination of mercury, bromine, arsenic, and cadmium in biological samples is described. Following neutron activation and a simple distillation of volatile compounds, mercury and bromine were determined by gamma spectrometry. Arsenic and cadmium were further separated by cation exchange separation and determined similarly. Determination limits for mercury, bromine, arsenic, and cadmium were 0.001, 0.003, 0.001, and 0.02 μg, respectively. The method has been applied to the determination of mercury, bromine, arsenic, and cadmium in rice and fish samples. Analysis of a standard kale powder yielded the values of 0.046 μg/g for mercury, 5.24 μg/g for bromine, 0.17 μg/g for arsenic, and 0.50 μg/g for cadmium. (Korean Sci. Abstr.)

Chemical and Spectral Procedures

Refer also to abstracts 15034–15036, 15454, 15706, and 15708.

14801 (EUR-5125) DETERMINATION OF MERCURY BY CONTROLLED POTENTIAL COULOMETRY: AN OUTLAY FOR AUTOMATIC PERFORMANCE. Muntau, H.; Cenci, R. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). May 1974. 22p. Dep. NTIS (US Sales Only) $4.25. EUR B.Fr. 40.-.

The determination of mercury by controlled-potential coulometry in the presence of $CaBr_2$ concentrations between 0.05 and 1.5 M and HBr concentrations between 0.1 and 1.0 M is possible using perchloric acid as a basal electrolyte. The mercury amounts needed for each determination range from ca. 40 mg to 10 μg. The precision obtainable is better than 0.25% for the higher concentration range (e.g., between 1 and 40 mg). This determination was made in a study of the HgO precipitation and $CaBr_2$ regeneration step of hydrogen production by nuclear heat. (auth)

14802 (IFTJ-49/1) USE OF CHELATING ION EXCHANGER IN CONJUNCTION WITH RADIOISOTOPE X-RAY SPECTROMETRY FOR DETERMINATION OF TRACE AMOUNTS OF METALS IN WATER. Holynska, B. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). Feb 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

The chelating ion exchange resin Chelex-100 was applied for collection of trace amounts of several metal ions from water solutions. The kinetics of the exchange reaction were measured, as well as the influence of pH of the solution and Ca or Na ions concentrations on the metal collection. The radioisotope x-ray fluorescence method was applied for determination of metal ions absorbed in the resin. The estimated limit of determination is 0.01 ppM for Fe^{3+}, Zn^{2+}, Cu^{2+}, Hg^{2+}, Pb^{2+}, and Cd^{2+}. Total error /1s/ of the method varied from 3 to 15% depending on the metal concentration. (auth)

14803 (IFTJ-52/1) STREAM RADIOISOTOPE X-RAY FLUORESCENCE ANALYSER FOR THE DETERMINATION OF CALCIUM AND IRON IN LIME STONE SLIME. Wasilewska, M.; Ostachowicz, J.; Owsiak, T. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). 1974. 40p. (In Polish). Dep. NTIS (US Sales Only) $5.00.

An "on stream" analyzer and a radiometric method for continuous determination of calcium and iron contents in limestone slime are described. The analyzer consists essentially of a radioisotope x-ray fluorescence measuring head and electronic unit. The characteristic radiation of Ca and Fe K series is excited by a ^{109}Cd radioisotope source. The total error /1s/ of determination of CaO and Fe_2O_3 is ±0.7% CaO and 0.15% Fe_2O_3 for the concentration range 39 to 46% CaO and 0.6 to 3.6% Fe_2O_3 respectively. Time of measurement does not exceed 2 min. The "on stream" analyzer has been successfully operated in "Przyjaźń" cement plant. (auth)

14804 (IS-T-644) DETERMINATION OF TRACE RARE EARTH IMPURITIES IN LUTETIUM BY X-RAY EXCITED OPTICAL LUMINESCENCE. Tritten, J. S. (Ames Lab., Iowa (USA)). May 1974. Contract W-7405-eng-82. 71p. Dep. NTIS $6.75.

Thesis.

The x-ray excited optical luminescent determination of holmium, erbium, thulium, and ytterbium at concentrations of a fractional ppM to 100 ppM in lutetium was studied. An analytically effective lutetium vanadate host for the luminescence of the rare earths was identified and optimized. The use of the internal reference element samarium was found to make the analyses much more precise than the methods now available for the determinations of trace rare earths in lutetium (i.e., mass spectroscopy and uv-excited luminescence). The XEOL method was shown to be as sensitive as the mass spectroscopic analysis for a much lower cost and shorter determination time. Linear calibration curves were obtained from prepared samples and even the addition of up to 500 ppM of iron, aluminum, calcium, magnesium, and/or nickel did not affect the linearity. (auth)

14805 (LA-5539) DETERMINATION OF SELECTED RARE EARTHS IN URANIUM ALLOYS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY, Gardner, R. D.; Henicksman, A. L.; Ashley, W. H. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Scandium, yttrium, holmium, erbium, thulium, ytterbium, and lutetium, at concentrations of 0.01 to 0.1 wt% in uranium-matrix alloys, are determined by atomic-absorption spectrophotometry in a perchloric acid solution of the alloy without separation. The presence of uranium enhances the absorbances of the rare-earth elements and eliminates interferences by other elements. The measurement's relative standard deviation at the 0.1-wt% level is 1%, except for lutetium for which it is 5%. At the 0.01-wt% concentration level, each element except lutetium and yttrium is measured with a relative standard deviation no greater than 3%. For lutetium and yttrium, the relative standard deviations are 10 and 8%, respectively. (auth)

14806 (LA-5564) X-RAY SPECTROGRAPHIC DETERMINATION OF IRIDIUM IN LiH OR LiD. Hansel, J. M.; Hakkila, E. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb. 1974. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

Iridium is determined in LiH or LiD using a fusion-x-ray fluorescence technique. Samples are fused at 870°K, the residue is dissolved in HCl, and the solutions are fumed with HNO_3 to remove chloride. Platinum is added as an internal standard, and the intensities of the $L\alpha_1$ x rays of iridium and platinum are measured. The Ir/Pt x-ray intensity ratio is compared to ratios measured for reference materials having known compositions which have been prepared in the same manner as the samples. The relative standard deviation for measuring 1 to 10 mg of iridium is between 2 and 0.4%. Thulium and lutetium interfere when present in amounts greater than approximately 1%. (auth)

14807 (RLO-2227-T-14-15) NUCLEAR CHEMISTRY RESEARCH AT OREGON STATE UNIVERSITY. Annual Progress Report, September 1, 1973–August 31, 1974. Thomas, T. D. (Oregon State Univ., Corvallis (USA). Radiation Center). 15 May 1974. Contract AT(45-1)-2227. 38p. Dep. NTIS $5.00.

Research progress on photoelectron spectroscopy, Moessbauer spectroscopy, nuclear reactions, and new techniques in x-ray photoelectron spectroscopy is summarized. A list of publications is included. (MCG)

14808 DETERMINATION OF Hf IN THE PRESENCE OF Zr WITH CUPFERRON AND MANDELIC AND SULFOSALICYLIC ACIDS. Karlysheva, K. F.; Malinko, L. A.; Koshel, A. V.; Vashun, L. F. (Inst. of General and Inorganic Chemistry, Kiev). Ukr. Khim. Zh.; 40: No. 2, 193-196(Feb 1974). (In Russian).

A method is described for determining Hf in the presence of Zr in perchloric, sulfuric, and hydrochloric acid solutions using mandelic acid, cupferron, and sulfosalicylic acid, respectively. From 5.0 to 99.0 wt % HfO_2 can be determined in 2-4 hr. The error of the determination is no greater than ± 1.5%. (tr-auth)

14809 INTERFERENCE AND ELIMINATION OF MOLYBDENUM AND CHROMIUM IN ATOMIC ABSORPTION ANALYSIS AND QUANTITATIVE DETERMINATION OF THESE ELEMENTS IN STEEL. Maruta, T.; Takeuchi, T. (Nagoya Univ., Japan). Bunseki Kiki; 11: No. 8, 502-510(Aug 1973). (In Japanese).

For analysis of molybdenum the wavelength of 313.3 nm was used for measurement using a nitrous oxide-acetylene flame. With the addition of hydroxylamine hydrochloride the specimen was heated and measured. Regardless of the state of the flame, the absorbancy of molybdenum was fixed even if the concentration of iron (0 to 10,000 ppM) was changed. Addition of phosphoric acid (0.05 mg/mol) stabilized the effect of iron, irrelative of the state of the flame. Addition of hydroxylamine hydrochloride in the presence of iron did not result in an interference by nickel, chromium, and vanadium in the absorbance of molybdenum. The values from quantitative determination of molybdenum in the standard steel agreed well with the standard value, the coefficient of variability of measurement values being about 2%. For the analysis of chromium, the wavelength of 357.9 nm was measured using the air-acetylene flame. Although iron inhibited absorption of the chromium(III) solution, in case of chromium(IV), increase in the iron concentration augmented the absorbance up to 50 ppM, followed by a decrease. The interference of iron could be inhibited by the addition of hydroxylamine hydrochloride and 0-phenanthroline. The nitrous oxide-acetylene flame lowered the sensitivity of chromium, but there was no interference by the coexisting elements. The quantitative determination of chromium in the standard steel agreed with the standard value. In the absorption analysis by flameless atomization using tantalum filament, the detectable limit of chromium was 9.4×10^{-11} g., the sensitivity 5.2×10^{-11} g., and the coefficient of variability 2.8%. One analysis was completed in 2 minutes. For the absorption analysis of 6 ppM of chromium solution, iron, copper, manganese, and aluminum in 10-fold, 50-fold, and 100-fold amounts of chromium did not show interference. The present method was thought to be accurate, precise, convenient, and rapid in the analysis of the standard iron and steel. (JA)

14810 INDIRECT DETERMINATION OF TANTALUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Matsuo, T.; Shida, J.; Kudo, S. (Yamagata Univ., Yonezawa, Japan). Bull. Chem. Soc. Jap.; 46: No. 11, 3595-3596(Nov 1973).

An indirect determination of tantalum by atomic absorption spectrometry was investigated. The essential steps in this method are: formation of molybdotantalate, extraction of the molybdotantalate, extraction of the molybdotantalate with methyl isobutyl ketone (MIBK) and measurement of molybdenum by aspirating the MIBK extract directly into the burner of the atomic absorption spectrophotometer. (LK)

14811 SPECTRO-ISOTOPIC ANALYSIS OF LITHIUM USING THE HOLLOW CATHODE DISCHARGE TECHNIQUE. Fukusima, H. (Japan Atomic Energy Research Inst., Tokai). Bunko Kenkyu; 21: No. 6, 416-422(Dec 1972). (In Japanese).

The measurement of the relative isotopic amounts of Li of given samples was performed using the combination of interference filter and Fabry-Perot interferometer (Etalon). In this combination complex adjustment of optic axes, which is required in the combination of diffraction grating monochromater and Etalon, is not necessary and sufficient brightness can be obtained. The hollow cathode discharge tube with cooling unit was used as excitation light source in order to obtain a narrow spectral line. LiI resonance line (6708 Å, double lines of 0.16 Å space) was used for observation. On the measurement of the degree of enrichment the length of spacer of Etalon was adjusted so that the weaker line of ^{6}Li and the stronger line of ^{7}Li of the next order superimpose each other and the scanned interferogram becomes repeats of a couple of lines. Assuming the ratio of the intensities of the double lines of each isomer to be 2:1, an equation, ^{6}Li at. % = $(2x - 1/x + 1) \times 100$, was used to determine the enrichment. A series of the standard samples was prepared by mixing $^6Li_2CO_3$ and $^7Li_2CO_3$ of required solid weight ratios and converting the $^{6-7}Li_2CO_3$ to $^{6-7}Li_2SO_4$. Following are examples of the experimental results: analytical value, at. % (exp. result) 9.65 ± 0.34 for standard sample of ^{6}Li conc. 10.19 at. %, 20.90 ± 0.32 for 20.31, 60.40 ± 0.38 for 60.23, and 99.36 ± 0.25 for 99.3 at. %. The required time for measurement of the samples was 1 hr after starting discharge, the measurable region was 1.0-99.0 at. %, and accuracy was 0.2-0.5 absolute at. %. (JA)

14812 TITRATION OF SALTS OF RARE-EARTH METALS IN A MEDIUM OF ANHYDROUS MIXED SOLVENTS. Kreshkov, A. P.; Milaev, S. M.; Manzhigeeva, V. K. Tr. Mosk. Khim.-Tekhnol. Inst.; No. 71, 253-254(1972). (In Russian).

The perchlorates of the lanthanoids, Y, Cu, Mg, Ca, Zn, and Cd can be titrated potentiometrically in a medium of dimethylformamide-ethyl methyl ketone (1:10) with 0.1 N tetraethylammonium hydroxide solution in benzene-ethanol, with use of a glass electrode and a silver-AgCl electrode in saturated butanolic KCl. As the perchlorates of the various metals are acids of different strengths, the conditions indicated can be used for analyzing binary mixtures (e.g., Yb-La), and ternary mixtures of two perchlorates plus $HClO_4$. (Referativnyi Zh.)

14813 DIFFERENCE-PHOTOMETRIC DETERMINATION OF RARE-EARTH METALS AFTER EXTRACTION OF THEIR COMPLEXES WITH METHYLTHYMOL BLUE AND DIPHENYLGUANIDINE. Akhmedli, M. K.; Granovskaya, P. B.; Neimatova, R. A. Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk; No. 3, 25-31(1972). (In Russian).

The method involves extraction of the ternary complexes of these elements into isoamyl alcohol from an aqueous medium of pH 5 to 6.5 for elements of the Ce sub-group, or pH 4.35 to 5.0 for members of the Y sub-group, for measurement at 610 nm. The values of ϵ range from 27,000 to 40,000, and Beer's law is obeyed for 0.9 to 1.66 mg of a rare-earth metal in 25 ml of extract. The method has been used for determining rare-earth metals in alloys. (Referativnyi Zh.)

14814 STUDY AND SPECTROPHOTOMETRIC DETERMINATION OF Mo(VI) WITH 2-HYDROXY-5-NITROBENZENE-1, 1'-AZO-β-NAPHTHOL. Popa, G.; Dumitrescu, V. An. Univ. Bucuresti, Chim.; 22: No. 1, 13-20(1973). (In Rumanian).

A spectrophotometric study was made of the Mo(VI) reaction with 2-hydroxy-5-nitrobenzene-1,1'-azo-β naphthol in the water-acetone solution, and by extraction into chloroform. In the water-acetone solution the complex compound has the maximum absorption at 560 nm, and in chloroform at 555 nm. The mentioned method permits the determination of Mo(VI) between concentration limits 1 to 20 μg Mo(VI)/cm^3 in the water-acetone solution and 0.4 to 12 μg Mo(VI)/cm^3 in chloroform. The interference of other ions was studied and also, the molar ratio and the instability constant of the compound. (auth)

14815 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM BY FERRON. Shivahare, G. C.; Mathur, M. K.; Mathur, S. (Univ. of Rajasthan, Jaipur, India). Indian J. Chem.; 2: No. 12, 1327-1328(Dec 1973).

Niobium forms a bottle-green water-soluble complex with 8-hydroxy-7-iodoquinoline-5-sulphonic acid (ferron) at pH 9-9.5. The reaction was used for the spectrophotometric determination of niobium in the presence of tantalum, tungsten, calcium, and some other ions. (auth)

14816 ATOMIC ABSORPTION ANALYSIS OF BERYLLIUM AND VANADIUM IN ROCKS. Terashima, S. (Geological Survey of Japan, Kawasaki). Jap. Anal.; 22: No. 10, 1317-1323(Oct 1973). (In Japanese).

A method was proposed for the determination of beryllium and vanadium in minerals and rocks by the atomic absorption spectrometry in a nitrous oxide-acetylene flame. The interference of aluminum on the determination of beryllium was eliminated by adjusting the height of the light beam at 8 to 10 mm above the burner top. The interference of diverse ions on the determination of vanadium was suppressed by the presence of aluminum. The molecular absorption with aluminum, titanium, calcium, potassium, etc., on the trace analysis of beryllium and vanadium was cancelled by adding appropriate amounts of aluminum, calcium, and potassium to the standards. The contents of 0.04 to 10 ppM beryllium in samples of various rocks, including ultramafic and carbonate rocks, were determined by the atomic absorption spectrometry after an extraction of beryllium acetylacetonate with chloroform. For the determination of beryllium in a beryl crystal and beryl ores, 0.1 to 0.2 g of sample was fused with a mixture of 2 g sodium carbonate and 0.3 g boric acid, and the melt was dissolved in HCl. The complete procedure of this method required about 15 min. The results on beryllium and vanadium in some standard samples agreed well with those obtained by other methods. (auth)

14817 AMPEROMETRIC TITRATION OF Ti, Zr, AND Hf WITH N-CINNAMOYLPHENYLHYDROXYLAMINE. Pilipenko, A. T.; Shpak, E. A.; Samchuk, A. I. (Kiev State Univ.). Ukr. Khim. Zh.; 40: No. 3, 266-268(Mar 1974). (In Russian).

An amperometric method was developed for titrating Ti and Zr with N-cinnamoylphenylhydroxylamine solution in the presence of Al, Cr, Ni, Co, Fe, and Mn in titanites. The ratio of Ti to the reagent was found to be 1:2 and of Zr to the reagent, 1:4 in the extracted compound. (tr-auth)

14818 DETERMINATION OF TRACES OF BORON IN HEAT-RESISTING ALLOY STANDARDS BY ISOTOPE DILUTION MASS SPECTROMETRY. Tamura, S. (Japan Atomic Energy Research Inst., Tokai). Shitsuryo Bunseki; 21: No. 4, 283-292(Dec 1974). (In Japanese).

Traces (0.6 ~ 130 ppM) of boron in heat-resisting alloy standards of JAERI (Japan Atomic Energy Research Institute) and of NBS (National Bureau of Standards, U. S.) were determined by isotope dilution mass spectrometry which involved addition of 95% enriched boron-10 as the spike and isolation of boron from acid solution of samples by methyl borate distillation. The tantalum ribbon single filament technique was used for isotopic analysis of boron. Except for one JAERI standard, the results obtained by isotope dilution gave a relative standard deviation of less than 3%. Determination of boron in boron-added water samples, fly ash standard NBS 1633 and geochemical rock standards JG-1 and JB-1 was also carried out for comparison. (auth)

14819 ARSENATE-IODIMETRIC DETERMINATION OF YTTERBIUM AND CERIUM(IV) IN ADMIXTURE. Eichiev, A. B.; Mamedov, I. A.; Nabiev, M. N. Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk; No. 3, 17-20(1972). (In Russian).

The method involves precipitation of total Yb and Ce (as arsenates) from an aliquot of test solution at pH 4.0; the precipitate is then dissolved in H_2SO_4 (2:5), and the liberated $As^{(V)}$ is determined via oxidation of KI and titration of the resulting iodine with 0.1N-$Na_2S_2O_3$. In a second aliquot of the test solution, $Ce^{(IV)}$ alone is determined via oxidation of KI and similar titration; the Yb is determined by difference. (Referativnyi Zh.)

14820 ISOTOPIC METHOD FOR THE ANALYSIS OF HAILSTONES. Pontikis, C.; Rigard, A. (Ministere des Transports, Paris). Meteorologie; No. 23, 51-56(Jul 1972). (In French).

A method is described for determining the variation of the isotopic D/H ratio with temperature. The method is more accurate than classical methods, and has the added advantage of permitting the use of a low resolution (300 to 500) mass spectrometer for delicate determinations. (FR)

14821 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM(VI). Arunachalam, M. K.; Kumaran, M. K. (Calicut Univ., India). Talanta; 21: No. 5, 355-358(May 1974).

Molybdenum(VI) gives a red color with ammonium thiocyanate in 5 to 8M hydrochloric acid medium, the Sandell sensitivity index being 0.018 ppM Mo(VI)/cm^2. Molybdenum(VI) in 4 to 7M hydrochloric acid medium forms a red complex with ethyl xanthate and ammonium thiocyanate and this can be extracted into acetophenone. Beer's law is obeyed over the range of 1.2 to 13.8 ppM, and the Sandell indices at 370 and 470 nm are 0.0016 and 0.0088 ppM/cm^2 respectively. The color is stable for 40 hr. Most cations do not interfere. (auth)

14822 METAL IMPURITIES IN UO_2-SiO_2 VITROCERAMICS. Beleuta, I. L. (Inst. for Atomic Physics, Bucharest). Radiochem. Radioanal. Lett.; 17: No. 5-6, 325-334(30 Jun 1974).

This work presents a continuation of a preliminary study on Cu, Fe, Cr, and Ni ions distributions in the UO_2-SiO_2 vitroceramics injected by gas pressure into copper or stainless steel moulds. The determination of each of the four ions along depth have been carried out for various wall thicknesses and UO_2 stoichiometries. (auth)

14823 BURN-UP DETERMINATION OF FAST REACTOR FUELS BY SIMPLIFIED MASS SPECTROMETRIC ANALYSIS OF ^{148}Nd. Koch, L.; Moy, T.; Steinert, D. (Commission of the European Communities, Karlsruhe (F.R. Germany). European Inst. for Transuranium Elements). Radiochim. Acta; 19: No. 2, 94-96(1973). (In German).

2 figs.; 3 tabs.; 3 refs.

The burn-up determination of fast reactor fuels by mass spectrometric isotope dilution analysis of ^{148}Nd can be simplified. In contrast to thermal reactors, the neutron capture of ^{149}Sm is negligible, which eliminates any interference of the spike isotope ^{150}Nd with the isobaric ^{150}Sm. This together with the higher burn-up and plutonium content enables a direct mass spectrometric measurement of uranium, plutonium, and neodymium to be made without any chemical separation. The procedure and the accuracy of the method are given. (GE)

14824 CONTRIBUTIONS TO THE ANALYSIS OF NUCLEAR RAW MATERIALS. VI. Spectrophotometric Determination of Cobalt in Yellow Cake Samples, Uranium-Bearing Minerals, and Geological Standard Samples. Korkisch, J.; Dimitriadis, D. (Univ., Vienna). Mikrochim. Acta; No. 3, 549-560(1974). (In German).

A method is described by which μg quantities of cobalt can be separated from large amounts of other ions, including uranium, and determined spectrophotometrically. The cobalt is separated from most other elements by adsorption on a column of the strongly basic anion exchange resin, Dowex 1-X8 (chloride form) from a mixed aqueous-organic solvent consisting of 50% (by volume) tetrahydrofurane, 40% glycol monomethylether, 10% 6 M HCl. Elution with 6 M HCl leaves the uranium on the column but displaces the cobalt, which is determined spectrophotometrically in the eluate, by the nitroso-R-salt method. The method was used for the determination of cobalt in Yellow Cake samples (4-16 ppM Co), uranium minerals (5-100 ppM Co), IAEA Standard Samples and radioactive ore standards (4-90 ppM Co), geochemical standard samples (1.2-86 ppM Co) and a standard sample of synthetic glass (1000 ppM Co_3O_4). In all cases the results agreed well. (auth)

14825 DETERMINATION OF TRACE CONTAMINANTS IN RAW MATERIALS FOR THE POWDER METALLURGICAL TUNGSTEN PRODUCTION. Lassner, E.; Ortner, H. M.; Schedle, H.; Kantuscher, E.; Klupacek, U. (Metallwerk Plansee, Reutte, Austria). Mikrochim. Acta; No. 3, 483-492(1974). (In German).

Trace contaminants can be distributed in solid materials homogeneously or heterogeneously. Heterogeneous contaminants especially may cause serious defects in sintered metals. Their exact evaluation is important for a reliable quality control of raw materials in powder metallurgy. Therefore, an analysis scheme is introduced for the determination of both homogeneous and heterogeneous trace impurities in raw materials for the tungsten production. A sample weight of 50 g ensures the statistically reliable analysis of heterogeneous impurities. The following homogeneously distributed trace elements can also be determined: Al, P, Ca, Ba, Mn, Fe, Co, Ni, Cu, Zn, and Mo. (auth)

14826 PHOTOMETRIC TITRATION OF PHOSPHATE WITH THORIUM NITRATE IN THE MICROGRAM AND MILLIGRAM RANGE. Harzdorf, C. (Bayerische Anorganisch-Analytischen Laboratorium, Leverkusen, Ger.). Mikrochim. Acta; No. 3, 461-467(1974). (In German).

A method for photometric titration of phosphate with thorium nitrate was developed. Pyrocatechol Violet serves as an indicator. The suitable range is between 5 μg and 2 mg P. The method works at a low pH level and therefore, most of the uni- and bivalent cations do not interfere. Appreciable amounts of alkali salts do not affect the titration either. Therefore, the method is applicable especially to the determination of phosphorus in organic compounds after decomposition with sodium peroxide. (auth)

14827 CONTRIBUTIONS TO THE ANALYSIS OF NUCLEAR RAW MATERIALS. V. Spectrophotometric Determination of Cadmium in Yellow Cake Samples, Uranium-Bearing Minerals, and Geological Standard Samples. Korkisch, J.; Dimitriadis, D. (Univ., Vienna). Mikrochim. Acta; No. 3, 449-459(1974). (In German).

A method is described for the separation of μg-amounts of cadmium from large quantities of foreign ions and for the spectrophotometric determination of the cadmium. The separation is accomplished by adsorption on the strongly basic anion exchanger Dowex 1-X8 (chloride form) from 1,2 M hydrochloric acid solution. After removal of the coadsorbed zinc by means of afterwashing with 0.15 M hydrobromic acid, the cadmium is eluted with nitric acid and determined spectrophotometrically in the eluate by the dithizone method. The method was employed for the determination of cadmium in Yellow Cake samples (0.24 to 0.65 ppM Cd), in uranium-bearing minerals (0.4 to 13.0 ppM Cd), in IAEA-standard samples and radioactive ore samples (0.19 to 3.5 ppM Cd), in geochemical standard samples (0.4 to 2.8 ppM Cd) and in standard samples prepared from synthetic glass (1000 ppM Cd). The results agreed well in all cases. (auth)

14828 SELECTIVE DETECTION OF FERRIC, COBALT(II), AND MOLYBDATE IONS USING M-(MERCAPTOACETAMIDO)-PHENOL AS A REAGENT. Kakkar, S. N.; Bhagwat, V.; Sarwan Singh, H.; Poonia, N. S. (Vikram Univ., Ujjain, India). Mikrochim. Acta; No. 3, 403-408(1974).

m-(Mercaptoacetamido)phenol (m-MAP) is used for the selective and characteristic detection of ferric ion, cobalt, and molybdate. The reagent produces deep green precipitate at pH6 with ferric ion in the absence of tartrate, purple red precipitate with cobalt around pH7 even in the presence of tartrate, and reduces molybdate to a yellow green to blue solution below pH3. The sensitivity of the cobalt test is exceptionally high. The three elements can be tested in the presence of each other and the related metal ions. (auth)

14829 USE OF XENON DIFLUORIDE FOR THE DETERMINATION OF SULFUR, SELENIUM, AND TELLURIUM AS THE VOLATILE FLUORIDES BY GAS CHROMATOGRAPHY. Aleinikov, N. N.; Sokolov, D. N.; Golubeva, L. K.; Korsunskii, B. L.; Dubovitskii, F. I. (Inst. of Chemical Physics, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 11, 2552-2554(Nov 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 11, 2614-2616(Nov 1973).

A method was developed for the analysis of elements as the volatile fluorides by employing the method of reaction gas chromatography and xenon difluoride as the fluorinating agent. The procedure was used to analyze for sulfur, selenium, and tellurium in a number of compounds. (auth)

14830 FAST METHOD FOR EXTRACTION AND SEPARATION OF RHENIUM(VII). Patil, S. P.; Shinde, V. M. (Shivaji Univ., Kolhapur, India). Separ. Sci.; 9: No. 3, 249-255(Jun 1974).

Separation of rhenium(VII) from molybdenum, vanadium, chromium, tungsten, iron, cobalt, nickel, copper, manganese, iridium, ruthenium, and uranium is achieved by solvent extraction with 4-methyl-2-pentanol either from sulfuric or hydrochloric acid media. Rhenium is determined directly in the organic phase as its thiocyanate complex at 430 nm. The method is shown to be applicable to synthetic mixtures and alloy steel. (auth)

14831 DETERMINATION OF URANIUM IN NICKEL-BASED ALLOYS BY PHOTOMETRIC TITRATION. Matous, K.; Tomik, B. (Inst. of Mines, Ostrava, Czech.). Hutn. Listy; 28: No. 9, 663-664(1973). (In Czech.).

Uranium in a solution of the sample in H_2SO_4 (1:3) was reduced by a bismuth reductor and was then titrated photometrically (at 540 nm) with NH_4VO_3 solution with Ba diphenylaminesulfonate as indicator. The method gave good results on samples containing 3 to 15 mg of U in the presence of up to a 180-fold excess of Ni. (Anal. Abstr.)

14832 GAS-CHROMATOGRAPHIC DETERMINATION OF XENON DIFLUORIDE. Gnauck, G.; Schoen, H. (VEB Technische Gase, Leipzig). Z. Chem.; 13: No. 8, 302(1973). (In German).

The sample of XeF_2 in helium, neon, argon, krypton, or nitrogen (0.1 to 5 ml according to the concentration) is analyzed at 23°C on a 4-ft column packed with Porapak Q (80 to 100 mesh), with Ar, He, or Ne as carrier gas (35 ml per min) and a $^{90}Sr-Ar$ microdetector, a gas-density balance or, for trace analysis, an electron-capture detector. A thermal-conductivity detector can only be used if the filament is protected with PTFE. The range of the method is 10 ppm to 1% (v/v). (Anal. Abstr.)

14833 POTENTIOMETRIC TITRATION OF NON-AQUEOUS SOLUTIONS OF RARE EARTH IODIDES AND THEIR MIXTURES. Kreshkov, A. P.; Milaev, S. M.; Manzhigeeva, V. K. (Moscow Chemicotechnological Inst.). Zh. Anal. Khim.; 29: No. 5, 914-917 (May 1974). (In Russian).

Acid-base properties of nonaqueous solutions of rare earth iodides were studied. It was established that rare earth iodides behave as acids in acetone media. Procedures were worked out

for determining rare earth iodides and differential analysis of their mixtures on the basis of the direct titration of their acetone solutions with a standard isopropanol solution of potassium hydroxide. A procedure is suggested for differential titrating mixtures of rare earth iodides with iodides of some other metals. (auth)

14834 EXTRACTION-SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN ALKALI METAL HALIDES. Pavlenko, L. I.; Petrukhin, O. M.; Zolotov, Yu. A.; Karyakin, A. V.; Gavrilina, G. N.; Tumanova, I. E. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 29: No. 5, 933-937(May 1974). (In Russian).

An extraction spectrographic method was worked out of determining 18 elements in alkali metal halides over a range of 10^{-5} to 10^{-7}%. (auth)

14835 DETECTION OF IODINE AND IODINE-CONTAINING SUBSTANCES IN BIOLOGICAL MATERIAL. Machata, G. (Univ., Vienna). Beitr. Gerichtl. Med.; 30: 284-288(1973). (In German).

In a case of poisoning with tincture of iodine, homogenized samples of body fluids and organs were evaporated with ethanolic KOH and the residues were ashed at 530°C. The ashes were extracted with H_2O and the filtered extracts were oxidized at pH 8 to 10 by boiling with aqueous $KMnO_4$; ethanol was added to coagulate the precipitate, which was removed by filtration. The filtrate was acidified with HCl, KI solution was added, the solution was extracted with $CHCl_3$, and the extinction of the $CHCl_3$ extract was measured at 515 nm to obtain the iodine content. In cases of poisoning with x-ray-contrast material, samples of body fluids and organs were frozen at −25°C and freeze-dried. The residues were powdered, ground with microcrystalline wax and compressed into tablets. Iodine was determined by x-ray fluorescence analysis, using the Kα line, a LiF crystal and a scintillation counter. Standards were prepared by adding KI to the appropriate biological material. To eliminate matrix effects, the tablets could be diluted 1:10 with cellulose powder; one series of standards could then be used for all samples to cover the range 50 to 400 ppM on the original sample. (Anal. Abstr.)

Radiometric and Radiochemical Procedures

Refer also to abstracts 15075, 15421, 15432, 15435, 15447, 15470, 15567, 15575, 15587, 15640, 15647, 15649, 15868, 16019–16021, 16042, 16046, 16071, 16072, 16484, and 17776.

14836 (ARH-SA-188) DETERMINATION OF TRITIUM IN WASTE PROCESSING EFFLUENTS BY DISTILLATION AND LIQUID SCINTILLATION EMULSION COUNTING. Hamilton, R. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2130. 23p. (CONF-740636-2). Dep. NTIS $4.00.

From meeting of the American Chemical Society; Cheney, Washington, USA (13 Jun 1974).

As part of Atlantic Richfield Hanford Company's nuclear waste management program at Hanford, moderate to low levels of tritium must be analyzed in steam and process condensates containing comparable or higher levels of several other fission products to assure that any releases to the environment are minimal and pose no danger to the public. A modified distillation cleanup procedure was developed that will completely separate aqueous tritium samples from twelve radioactive isotopes commonly found in aged fission products mixtures. An emulsion type of liquid scintillation cocktail is used to incorporate a relatively large volume of the aqueous sample and maintain a tritium counting efficiency normally in excess of twenty percent. (auth)

14837 (CEA-R-4583) TECHNIQUES OF RADIOACTIVITY MEASUREMENT: ^{90}Sr IN MILK AND HUMAN BONES AND ^{3}H AND ^{226}Ra IN WATER; TO BE APPLIED TO SAMPLES COLLECTED IN IRAN. Rouhanizadeh, N.; Moghimi, D.; Nikpay, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Jul 1974. 16p. (In French). Dep. NTIS (US Sales Only) $4.00.

Work is being done to assess the present level of environmental radioactive pollution liable to affect man. ^{3}H, ^{90}Sr, and ^{226}Ra were selected among the chief radionuclides of importance. The techniques are summarized, and the values obtained for samples of milk, human bones, and water from Teheran are given. (auth)

14838 (IFTJ-51/1) RADIOMETRIC METHOD FOR DETERMINATION OF GOLD AND INDIUM IN ELECTROPLATING BATH AND WASHINGS. Holynska, B.; Lankosz, M.; Markowicz, A. Wasilewska, M. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). 1974. 32p. (In Polish). Dep. NTIS (US Sales Only) $4.75.

A radiometric method for determination of gold and indium in an electroplating bath and washings in the concentration range of 0.01 to 1.0% and 1 to 4 g/l for Au and In respectively, was developed. X-ray fluorescence of Au L_α and in K_α series, excited using radioisotope sources was measured. The matrix effect was eliminated by additional measurement of back-scattered primary radiation. The ratio of Au L x rays and back-scattered radiation is a linear function of gold concentration. The estimated total error /1 s/ for Au analysis is 0.002 to 0.01% Au depending on the Au concentration. For determination of indium the error amounts to 0.040 In/l. (auth)

14839 (TT-74-50011, pp 279-285) SEPARATE DETERMINATION OF Rn, RaA, RaB, AND RaC CONCENTRATIONS IN AIR FROM THE α-ACTIVITY DECAY CURVE OF A FILTER. Bakulin, V. N.; Starikov, B. G. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The relationships between radon and its decay products are of interest when studying turbulent agitation and contaminant washout processes in the lower troposphere. An examination of the different methods of separate determination of the concentrations of radon daughter products shows that only some of them yield satisfactory results at low atmospheric concentrations of radon. An analytical analog has been developed of the graphical method of separate determination of ^{218}Po, ^{214}Pb and ^{214}Bi concentrations from the curve of filter α-activity decay; the analog is as accurate as the least squares method for three unknowns, but the calculations are incomparably simpler. A comparison of these methods for known proportions of the radon decay products proved the adequacy of the proposed method. The existence of standard proportions between the short-lived radon decay products under natural conditions was demonstrated; they make it possible to determine the concentration of each of them from the α-decay curve within 11 to 60 min from the end of filtration. (auth)

14840 (TT-74-50011, pp 286-292) NEW METHODS OF MEASURING ^{220}Rn (THORON) EXHALATION AND SOME RESULTS. Styro, B. I.; Nedvetskaite, T. N.; Sen'ko, E. E. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Two new methods are proposed for the measurement of ^{220}Rn exhalation. One uses a Pearson collector combined with a decay chamber for radioactive emanations. In the other, the Pearson collector is replaced by an accumulation chamber connected to three auxiliary decay chambers through which the air flows in from the surrounding space with already decaying ^{220}Rn. At the same time, these chambers serve for equalizing the pressure in the accumulator. After passing through the decay chamber, the ^{220}Rn and ^{222}Rn daughter products formed there were trapped on an LFS-1 filter which, after 6 hours of ^{222}Rn daughter products decay, was brought into contact with an A-2 nuclear emulsion. The setups were calibrated with ^{232}Th salt which was in equilibrium with the decay products. Since the calibration coefficient at low sampling rates fluctuated between 2 and 5%, the air penetrating the decay chamber was ionized by corona discharge, which increased up to fifteenfold the filter's aerosol-trapping efficiency. The use of corona discharge and nuclear emulsions helped considerably in raising the lower sensitivity limit of ^{220}Rn exhalation measurement (10^{-17} to 10^{-18} Cl/cm^2 · sec depending on sampling duration). The error of ^{220}Rn exhalation measurement by these two methods does not exceed 20%. Data are provided on the diurnal variation in ^{220}Rn exhalation and mean exhalation values for various states of the earth's surface. (auth)

14841 (TT-74-50011, pp 297-309) SPECTROMETRIC METHOD OF MEASURING THE CONCENTRATION OF NATURAL RADIOACTIVE AEROSOLS. Labushkin, V. G.; Popov, V. I.; Ruzer, L. S. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A spectrometric method of determining the concentration of natural atmospheric radioactive aerosols formed by radon and thoron decay daughter products is discussed. The determination of radon daughter product concentrations is accompanied by measurement of the α^- and β^-activity of the disperse phase of aerosols deposited on a fine-fibered LFS-1 (AFA-RSP-10, 20) filter by means of scintillation spectrometric detection units. For a simultaneous measurement of the concentration of daughter products of both radon and thoron, a spectrometric unit can be used for the detection of α-radiation, composed of a 0.3 to 0.4 mm thick CsI (Tl) crystal of 63 mm diameter and a FEU-52 photomultiplier. It is demonstrated that the adoption of these spectroscopic methods considerably reduces the error and, in addition, facilitates determination of the self-absorption of α-radiation in the aerosol sample and the dust content of the air. An investigation was made of the spectrometric unit for the detection of α radiation from a

wide-area (over 100-cm²) aerosol sample. The unit consists of a CsI (Tl) crystal and a FEU-49 photomultiplier. The topography of the photocathode sensitivity was plotted with the aid of a ^{239}Pu spectrometric point source. The apparatus used for measuring the concentration of natural radioactive aerosols by spectrometric methods is described. (auth)

14842 (TT-74-50011, pp 310-314) ISOTOPE ANALYSIS OF RADIOACTIVE FALLOUT AND AEROSOL SAMPLES BY BETA-SPECTROMETRY. Silant'ev, A. N.; Polyakova, T. V.; Rabotnova, F. A.; Shkuratova, I. G. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A method is discussed for determining the content of radium-106, praseodymium-144, yttrium-90 and strontium-89 isotopes by beta-spectrometric analysis, involving the use of a scintillation beta-spectrometer with a plastic 20-mm-thick scintillator of 70-mm diameter. Only beta radiation of energies above 630 keV is taken into account when processing spectra. The measured spectra in the range of 630 keV to 3.5 MeV are subdivided into intervals, so that the following system of equations holds: $N_i = a_i^{89} S_{89} + a_i^{90} S_{90} + a_i^{144} S_{144} + a_i^{106} S_{106}$, $i = 1, 2, 3, 4$, where N_i is the number of pulses recorded in interval i, S is the number of pulses recorded in the interval above 630 keV, and a_i is the coefficient of transition from the number of pulses in interval i to the number of pulses recorded in the interval above 630 keV. The transition from the number of pulses recorded to the activity of the isotopes can be expressed by the formula: $N = A_0 \epsilon\omega (1-e^{-\mu d}/\mu d)$ where N is the counting rate in the interval above 630 keV, A_0 is the activity of the preparation, ϵ is the recording efficiency in the said interval, ω is the solid angle accounting for the angular distribution, d is the layer thickness, and μ is the coefficient of beta-radiation attenuation. (auth)

14843 (TT-74-50011, pp 319-334) GRAPHOANALYTICAL METHOD FOR DETERMINING CESIUM-137 CONCENTRATION IN SOIL SAMPLES FROM THE GAMMA SPECTRUM. Churkin, V. N. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The high-energy part of the amplitude distribution of pulses in the region of the ^{137}Cs photopeak of 680 to 740 keV is shown to be fairly well approximated by a Gaussian curve, if the ^{137}Cs photopeak in the gamma spectrum of the soil samples is separated from the right-hand base of the curve "parallel to the level of the natural background." This facilitates graphoanalytical determination of the ^{137}Cs photopeak area along with calculation of the concentration of this isotope in the soil. Components due to interfering radiation of natural and artificial isotopes need not be taken into account. The threshold sensitivity for a 50% statistical error of measurement is 2.10^{-12} curie/g. The method is five to eight times as efficient as known methods. It is assumed that it also applies to measurements in situ, e.g., when ^{137}Cs concentration in the soil cover is investigated from aboard aircraft or automobiles. (auth)

14844 (TT-74-50011, pp 335-339) RADIOCHEMICAL METHOD OF DETERMINING LOW STRONTIUM-90 CONCENTRATION LEVELS IN ENVIRONMENTAL SAMPLES. Chumichev, V. B. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A radiochemical method for determining ^{90}Sr in 10 liters of seawater is described in detail. It involves a low-background radiometric setup (background of 4 to 6 counts per hour), intended for measuring the β-radiation of the daughter ^{90}Y. The method significantly facilitated the taking and preliminary processing of seawater samples, reduced the consumption of reagents such as soda and hydrochloric acid, eliminated the use of ammonium chloride, and increased the relative yield of strontium. Analysis of the carbonate concentrate became three times as efficient as analysis of the concentrate from a 100-liter sample. ^{90}Sr can be determined in 2-liter seawater samples without a flame photometer. The method was also used to study the sea bottom, at ^{90}Sr concentration levels of 10^{-12} Ci. (auth)

14845 SPECIFIC HIGH-SENSITIVITY DETERMINATION OF ^{131}I IN MILK. Daniel, S. H.; Bronson, F. L.; Kim, S. M. (Radiation Management Corp., Philadelphia). Trans. Amer. Nucl. Soc.; 18: 50(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14846 IN VIVO TISSUE ANALYSIS USING MU-MESIC X RAYS. Hutson, R. L. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 98-99(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14847 NEW DEVELOPMENTS IN ENERGY-DISPERSIVE X-RAY FLUORESCENCE ANALYSIS. Cooper, J. A.; Wogman, N. A. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 99-100(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

14848 CHOICE OF OPTIMUM GEOMETRIC CONDITIONS FOR RADIOISOTOPE X-RAY FLUORESCENCE ANALYSIS. II. Matsui, Y.; Furuta, T. (Government Industrial Research Inst., Nagoya, Japan). Radioisotopes (Tokyo); 22: No. 11, 615-622(Nov 1973). (In Japanese).

To obtain optimum geometrical conditions for radioisotope x-ray fluorescence analysis, the dependence of the characteristic x-ray intensity on the position of the source and the sample was derived theoretically and the result was compared with the experimental values. The characteristic x-ray intensity, FIP, which is generated from a point on the sample and measured by the detector, was considered to be proportional to the product of the geometrical efficiency $G(=\Omega/4\pi)$, the primary x-ray intensity from the source F, and the visible part of the detector window RA (i.e., the portion not shadowed by the source holder or so). The characteristic x-ray intensity FID was obtained by integrating FIP. The dependence of FID on the position of the source and the sample agreed well with the experimental results. (auth)

14849 ANALYSIS OF Ta-Nb PREPARATION BY RADIOMETRIC METHODS. Determination of Tantalum Using Substoichiometric Extraction With Tetraphenyl Phosphonium. Savkin, M. E.; Shamaev, V. I.; Martynov, A. M. (Chemical-Technical Inst., Moscow). Zh. Anal. Khim.; 29: No. 5, 1012-1014(May 1974). (In Russian).

The possibility has been studied of determining tantalum by using its substoichiometric separation with tetraphenyl phosphonium chloride into chloroform. The data obtained have been used to develop a method of determining tantalum in tantalum-niobium preparations. (auth)

14850 NEW SIMPLE METHODS FOR THE DETERMINATION OF SOME ACTINIDE ELEMENTS IN BIOASSAYS. Delle Site, A.; Santori, G.; Testa, C. (CNEN, Casaccia, Italy). pp 761-775 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The internal contamination due to alpha emitters must be evaluated by the determination of these elements in the excreta. Especially in cases of suspected acute contamination, the determination of some actinides (plutonium, americium, curium, neptunium) in the urine has to be carried out within a few hours to decide whether a therapeutical treatment with DTPA is necessary. Furthermore the presence of the chelating agent generally causes serious interferences when the most common methods reported in the literature are used. Therefore some new radiotoxicological techniques were prepared by the Radiotoxicological Laboratory of the Casaccia Nuclear Centre of CNEN (Rome) for the rapid determination of thorium, uranium, plutonium, americium, curium and neptunium in urine. All these methods are based on a batch extraction of the radionuclides from the wet mineralized urine by means of an organic extractant supported on a microporous polymer. Tri-n-octylphosphine (TOPO) and di(2-ethylhexyl)orthophosphoric acid (HDEHP) were used as the selective extractants, and a powder of microporous polyethylene (Microthene-710) was employed as the inert support. The urine is mineralized by boiling with nitric acid and stirred for 20 to 60 min. with the slurry Microthene-TOPO (for uranium, thorium, plutonium and neptunium) or Microthene-HDEHP (for americium and curium); the slurry is then transferred quantitatively into a chromatographic column and, after washing, the element is selectively eluted with a suitable solution. When the urgency is great the alpha counting can be carried out directly by a ZnS(Ag) detector; however a greater sensitivity limit can be achieved by electroplating the radionuclide and counting with a solid state detector; in this case alpha spectrometry can also be carried out. Thorium can be determined better by a final colorimetry with Arsenazo III. The final yields for enriched uranium, plutonium, neptunium, americium and curium range from 70 to 85% with a general sensitivity limit of about 0.1 pCi for a 24 hour sample; thorium gives a yield of 90% and a sensitivity limit of 0.2 μg/l. The blank values are sufficiently low and the decontamination factors are generally very high. The time required for one analysis ranges from 3 to 8 hours. As the extraction of the radionuclides is carried out in a nitric acid medium, DTPA does not interfere with the analysis. This

technique yielded excellent results also on the occasion of an IAEA intercomparison related to radiotoxicological analyses of human urine. (auth)

14851 MEASUREMENT OF $^{14}CO_2$ IN AIR EXHALED FROM THE LUNGS. Degani, N.; Roiz, Y. (Nuclear Research Center-Negev, Beersheba, Israel). pp 776-778 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

A quick method for monitoring exhaled $^{14}CO_2$ which can be used for health physics purposes and metabolic studies is described. The method, based on the absorption of CO_2 by hydroxide hyamine and counting the titrated solution in a liquid scintillation counter, can detect one investigation level in 10-20 minutes of counting. (auth)

14852 RAPID ROENTGENFLUORESCENCE ANALYSIS OF HEAVY METALS THROUGH RADIOACTIVE NUCLIDES USING A Ge(Li) DETECTOR. Karamanova, Z. S.; Bocvarov, N. S. (Inst. for Nuclear Research, Sofia). Isotopenpraxis; 10: No. 3, 100-104(Mar 1974). (In German).

The possibilities of using a Ge(Li) semiconductor detector for rapid analyses of heavy metals by the roentgenfluorescence method are investigated. Both binary samples of tungsten, lead, and uranium ore or concentrates and multi-component samples simultaneously containing tungsten, mercury, lead, bismuth and others, were analyzed. The analyses were performed using the characteristic K X-ray lines of elements having an activity of 3 mCi induced by ^{57}Co. The use of the harder K-lines for the analyses may considerably decrease the influence of some error sources involved in the roentgenfluorescence method with isotopes when compared with the soft L-lines. Registration of roentgen spectra was performed by a Ge(Li) large-volume detector (10 cm^3) having a resolution of 2 keV for the 122-keV line of ^{57}Co. The relative error ranges 0.4-0.5 percent. (auth)

14853 TRACE ELEMENTS ANALYSIS BY MEANS OF CHARGED PARTICLE INDUCED X RADIATION. Kajfosz, J. (Inst. of Nuclear Physics, Krakow). Postepy Fiz.; 25: No. 2, 159-173(1974). (In Polish).

Recent developments in the use of heavy charged particles for x-ray excitation in the analysis of trace elements in low-Z matrices are reviewed. Main technical aspects and the applicability of this method are briefly discussed. (auth)

14854 USE OF CHELATING ION EXCHANGER IN CONJUNCTION WITH RADIOISOTOPE X-RAY SPECTROMETRY FOR DETERMINATION OF TRACE AMOUNTS OF METALS IN WATER. Holynska, B. (Univ. of Mining and Metallurgy, Krakow). Radiochem. Radioanal. Lett.; 17: No. 5-6, 313-324(30 Jun 1974).

The chelating ion-exchange resin Chelex-100 was applied for collection of trace amounts of several metal ions from aqueous solutions. The kinetics of the exchange reaction was measured, as well as the influence of pH of the solution and Ca or Na ions concentrations on the metal collection. The radioisotope x-ray fluorescence method has been applied for determination of metal ions sorbed on the resin. (auth)

14855 NEW SCINTILLATOR IN LIQUID SCINTILLATION COUNTING AND A SIMPLIFIED METHOD OF SAMPLE PREPARATION FOR DETERMINATION OF TRITIUM OR CARBON-14. Kawakami, M.; Shimura, K. (Tohoku Univ., Sendai). Radioisotopes (Tokyo); 23: No. 2, 81-87(Feb 1974). (In Japanese).

Nonylphenoxypolyethoxyethanol-toluene scintillator (NT-scintillator) was found to possess excellent characteristics for counting tritium or carbon-14. Counting characteristics of the NT-scintillator for aqueous samples were examined in detail. By using 1N NaOH, 2N HCl, and the NT-scintillator, various samples were incorporated in large quantities as stable homogeneous solutions for extended periods and counted at a constant efficiency. The present method was also shown to be applicable for the determination of radioactivities of tritium and carbon-14 doubly labeled compounds with the least trouble. (auth)

14856 LIQUID SCINTILLATION COUNTING OF $^{35}SO_4^{2-}$ AND OTHER IONS IN PERCHLORATE DIGESTS OF PLANT TISSUE. Peirson, D. R. (Univ. of British Columbia, Vancouver). Can. J. Bot.; 52: No. 1, 177-179(Jan 1974).

An efficient, reliable, and economical technique is described which eliminates the problems associated with liquid scintillation counting of $^{35}SO_4^{2-}$. Acid digests of plant tissue are prepared for application to either filter paper or glass fiber, which acts as a carrier in the scintillator solution. The digests are also suitable for the assay of a number of other radioactive and stable isotopes. (auth)

14857 RAPID MEASUREMENT OF ASH CONTENT OF BROWN COAL. Joynt, R. C. At. Energy Aust.; 17: No. 2, 9-14(Apr 1974).

A description is given of a radiometric gauge for the measurement of the ash content in brown coal. Safety, calibration and performance testing are discussed. (AT)

14858 AMINO ACID SEQUENCE DETERMINATION WITH RADIOACTIVE PROTEINS. McKean, D. J.; Peters, E. H.; Waldby, I.; Smithies, O. (Univ. of Wisconsin, Madison). Biochemistry; 13: No. 15, 3048-3051(16 Jul 1974).

A procedure is described for quantitative analysis of amino acids based only on their radioisotope content. The effluent from a conventional amino acid analyzer is collected so that each amino acid is placed in a discrete fraction for subsequent scintillation counting. This procedure is applied to the analysis of the hydrolytic products of thiazolinones formed by the automatic degradation of proteins in the Edman-Begg sequenator. Sequence data derived solely from the radioisotope content of the protein under investigation are then obtained. The procedure was tested for 30 degradations with a uniformly ^{14}C-labeled peptide of 47 residues in length obtained from Brome Mosaic virus coat protein. The radioisotope sequence agreed completely with that derived from conventional chemical analysis. The radioisotope sequencing procedure can also be used with ^{3}H labels. The procedure is insensitive to the presence of nonradioactive proteins introduced accidentally or deliberately during the purification of the radioactive protein. (auth)

14859 RADIOCHEMICAL EVALUATION OF THE SEPARATION OF H_2SO_4 AEROSOL BY MICRODIFFUSION FROM VARIOUS FILTER MEDIA. Maddalone, R. F.; Shendrikar, A. D.; West, P. W. (Louisiana State Univ., Baton Rouge). Mikrochim. Acta; No. 3, 391-402(1974).

A series of filter media were tested for their utility as surfaces to diffuse H_2SO_4. Those filter media studied were: soft glass plate, Gelman A glass fiber filter paper, 5.0 μ Mitex (teflon), 0.5 μ Solvinert, 1.0 μ Nucleopore, Whatman 41 and Poco graphite filter. Time from 1 to 6 hours and temperature from 100° to 195° were investigated. It was found that the Mitex and the Poco graphite had the best diffusion characteristics, but both exhibit the same lower limit. (auth)

14860 METHOD OF INVESTIGATING THE α-ACTIVITY OF A SUBSTANCE RELATIVE TO SOURCE DEPTH. Kononovich, A. L.; Bogolapov, N. V.; Klochkov, V. N.; Konstantinov, I. E. Sov. J. At. Energy (Engl. Transl.); 33: No. 5, 1067(Nov 1972).

Translated from At. Energ. (USSR); 33: No. 5, 919(Nov 1972). This is a summary of paper No. 625/6753 with full copy held at TIC.

A spectrometric method is considered for the determination of the distribution law for the α-activity of a substance relative to source depth. The method is based on the application of matrices to the spectra obtained. During measurement, the samples of material were not subjected to any special treatment and did not disintegrate during the measuring process. A method was specially developed for studying sorption and diffusion in polymeric materials. Therefore, special consideration is given to the choice of geometric conditions for the measurement. Serial spectrometric equipment, incorporated into a 9063-02 Amur assembly, was utilized in the experiments. The control experiments indicated that the measurement technique is not sensitive over wide limits to mechanical changes in the shape of the samples. The matrices, enabling one to convert the α-radiation spectrogram for ^{239}Pu to the distribution function for the specimen inside the source, are cited. A control experiment was performed in which the distribution of plutonium nitrate in aqueous acid solution was measured. The error in the determination of the form of the distribution function (correct to an error in the normalization factor) did not exceed 5% on the average. (auth)

14861 QUANTITATIVE EVALUATION OF THE QUENCHING OF COLORED BIOLOGICAL SAMPLES. J. Nagy, E. (Radiological Akademiai Tanszeki Kutatocsoport, Budapest); Lendvay, J. Izotoptechnika; 17: No. 6, 309-315(Jun 1974). (In Hungarian).

Quenching in relation to the color of biological samples prepared for liquid scintillation measurement is discussed. Preliminary estimations of the quenching and decrease of its disturbing effect are presented. (auth)

14862 OXIDATION OF ^{85}Kr-LABELLED COPPER FILMS. Baird, T.; Bodys, J. W. S.; Campbell, K. C. (Glasgow Univ.). Int. J. Appl. Radiat. Isotop.; 25: No. 6, 269-275(Jun 1974).

^{85}Kr-labelled copper films have been shown to behave quantitatively and reproducibly as oxygen detectors over a wide range of operating conditions. Continued use of a film was not observed to reduce the amount of activity released in response to an oxygen sample. Anomalous behavior observed with fresh films and with

high oxygen dose rates has been related to the mechanism of copper oxidation and oxygen adsorption on cuprous oxide. Electron micrographs reveal evidence that the krypton must be more strongly bound than by purely mechanical trapping among the copper atoms. (auth)

Separation Procedures

Refer also to abstracts 14899, 15055, and 15068.

14863 (BM-RI-7823) INITIAL-STAGE SULFURIC ACID LEACHING KINETICS OF CHALCOPYRITE USING RADIOCHEMICAL TECHNIQUES. Baur, J. P.; Gibbs, H. L.; Wadsworth, M. E. (Bureau of Mines, Salt Lake City, Utah (USA). Salt Lake City Metallurgy Research Center). 1974. 42p. (PB-228628).

The sensitivity of radiochemical techniques makes possible the study of the initial-stage sulfuric acid leaching kinetics of chalcopyrite and other copper sulfide minerals. This Bureau of Mines study of the initial leaching of chalcopyrite used techniques to evaluate the molecular and electrochemical processes. High-grade Transvaal chalcopyrite was neutron-irradiated in a TRIGA reactor to produce radioisotopes copper-64, iron-59, and sulfur-35. Dissolution rates were measured in the time interval zero to 60 minutes, during which time significant anomalies were observed. First was an initial period of rapid dissolution lasting a few minutes; second, an arrest or "plateau" region usually lasting from 6 to 10 minutes; third, a second period of dissolution of lesser rate than the first. The effects of solution variables such as pH, oxygen partial pressure, and ferric ion concentration at different temperatures were measured. (auth)

14864 (IFJ-863) PHYSICOCHEMICAL INVESTIGATIONS ON THE EXTRACTION MECHANISM OF SOME ELEMENTS AND INORGANIC ACIDS BY QUATERNARY AMMONIUM SALTS. Szeglowski, Z. (Institute of Nuclear Physics, Krakow (Poland)). 1974. 116p. (In Polish). Dep. NTIS (US Sales Only) $9.00.

The extraction of rare earth and transplutonium elements, Tl, Pb, Bi, and Po, and also of HNO_3 and HCl, with chloroform solutions of cetylpyridinium salts was investigated. Measurements of conductivity and light absorption by cetylpyridinium salts solutions showed that the salts aggregate in chloroform solutions, forming micelles above a concentration of about 10^{-2} M. Surface tension and surface potential measurements proved that cetylpyridinium nitrate is not transferred to HNO_3 solutions in the extraction system, while cetylpyridinium chloride is transferred to HCl solutions. (auth)

14865 (NP-20065) RADIOCHEMICAL METHOD FOR THE DETERMINATION OF URANIUM, NEPTUNIUM, PLUTONIUM, TRANSPLUTONIUM, AND RARE EARTH ELEMENTS, IN SAMPLES OF AEROSOLS, RADIOACTIVE FALLOUT AND IN SOILS. Gedeonov, L. I.; Gritchenko, Z. G.; Makarova, T. P.; Maksimova, A. M.; Stepanov, A. V. (Radievyj Inst., Leningrad (USSR)). 1973. 16p. (In Russian). (RI-10). Dep. NTIS (US Sales Only) $4.00.

Methods were developed for determination of isotopes of several transuranium and rare earth elements in some environmental media. The separation of these elements is achieved by a combination of extraction, chromatographic and electromigration methods of analysis. The total rare earths and trivalent transplutonium elements is precipitated in fluoride form. The α-emitting nuclides are electrolytically deposited from dimethyl sulfoxide solutions. The yields of radiochemical procedures are monitored with the help of $^{152-154}$Eu, ^{243}Am, ^{237}Np, ^{238}Pu or ^{236}Pu isotopes, added to the sample during the initial stage of sample preparation. (auth)

14866 COEXTRACTION AND SUPPRESSION OF EXTRACTION OF TUNGSTEN AND MOLYBDENUM IN EXTRACTION FROM HALIDE SOLUTIONS BY TRIOCTYLAMINE AND TRIOCTYLBENZYLAMMONIUM SALTS. Bagreev, V. V.; Tseryuta, Yu. S.; Agrinskaya, N. A.; Zolotov, Yu. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 10, 2134-2138 (Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 10, 2183-2189 (Oct 1973).

In the joint extraction of molybdenum and tungsten compounds from solutions of HF, HCl, and HBr by trioctylamine and trioctylbenzylammonium salts, a coextraction or suppression of extraction of microquantities of one metal in the presence of macroquantities of the other is observed. The electric conductivity data show that in all the investigated organic phases the extractable compounds are dissociated to one degree or another. (auth)

14867 SEPARATION OF URANIUM AND NIOBIUM BY THE PREFERENTIAL CHLORINATION WITH HEXACHLOROPROPENE. Kanno, T.; Ito, K.; Hasegawa, S. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 148-151 (Dec 1972). (In Japanese).

In a V-shaped mixer, 1% Nb_2O_5 was mixed with 99% U_3O_8 for 1 hour. The mixture contained oxide of ^{92}Nb($T_{½}$ = 10.1 d, γ-ray 0.93 MeV) produced by the ^{93}Nb(γ, n)^{92}Nb reaction in the irradiation with a LINAC. This oxide was used as a tracer for examination of the separation. In the process 0.5 g of the U_3O_8-Nb_2O_5 mixture was allowed to react in 10 ml hexachloropropene kept at 100°C for 4 hours. The hexachloropropene reacted with U_3O_8 and formed an intermediate, $UCl_5 \cdot C_3Cl_4O$. The reaction product was separated from unreacted residue by alcohol extraction. The extent of separation of uranium and niobium was determined by measurement of the radioactivity of the residue on the filter paper and of filtrate. The γ spectrum showed that all the U_3O_8 has reacted with the hexachloropropene, and that no U_3O_8 remained on the filter paper. The γ spectrum of the filtrate also showed that very little niobium was present in the filtrate. It was thus confirmed that Nb_2O_5 hardly reacted with the hexachloropropene at 100°C. Separation coefficient calculated from count ratio was more than 200. It is expected that better separation will be secured by raising the temperature of the reaction product to 130°C at which pyrolysis takes place. Then uranium will be deposited as UCl_4. The hexachloropropene hardly reacts with ZrO_2. Therefore, the method of the present study is very promising for the treatment of used nuclear fuel. (JA)

14868 SYNERGISTIC EFFECTS ON THE SOLVENT EXTRACTION OF SOME RARE EARTH METAL IONS FROM ACETATE BUFFER SOLUTIONS. Yano, Y.; Kono, N.; Kondo, Y.; Nagashima, K. (Tokyo Univ.). Nippon Kagaku Kaishi; 1974: No. 2, 291-296 (Feb 1974). (In Japanese).

Synergism in the solvent extractions of La^{3+}, Gd^{3+}, and Yb^{3+} was studied. Metal ions in aqueous phase (~10^{-3} mol/l) were extracted into the xylene phase containing 2-theonyl-trifluoroacetone (TTA) and one of the organic bases, such as tri-n-butylphosphine oxide (TBPO), tri-n-octylphosphine oxide (TOPO), tri-n-butylphosphate (TBP), and α- and γ-picoline (α- and γ-Pic.), of various concentrations. The pH values of the aqueous phase were adjusted to 4.3 by adding acetate buffer solution and the extraction was performed at 60°C. The extraction percentage of each ion increased owing to the synergistic effect of the above bases in the following order: $La^{3+} > Gd^{3+} > Yb^{3+}$ in M^{3+}-TTA-TBP system. In the Gd^{3+}-TTA-base system, the order was TOPO, TBPO > TBP > γ- and α-Pic. Coordination of the acetate ion to the rare earth metal ion both in aqueous and organic solutions was confirmed and its role in extraction reaction was clarified. For every ion studied, the extracted complex $M(TTA)_2(CH_3COO)$ TBP was recognized in the organic phase. For La^{3+} and Yb^{3+}, complexes of another type as well as the above mentioned type were extracted because of their large or small ionic radii. In the Gd^{3+}-TTA-Pic system, $Gd(TTA)_3Pic$ was formed as extracted complex and there was no difference in the extraction behavior between α- and γ-picoline. It may be explained that picoline molecule does not coordinate to a metal atom in contrast with TBP, which is a stronger electron donor and forms direct bond to a metal atom. (auth)

14869 CONCENTRATION AND SEPARATION OF ELEMENTS ON HETEROPOLYACID SALTS. Sorption and Separation of Niobium and Titanium. Barkovskii, V. F.; Velikanova, T. V.; Kharchenko, L. P.; Semchuk, N. V. (Gorky State Univ., USSR). Zh. Anal. Khim.; 29: No. 5, 1014-1016 (May 1974). (In Russian).

The sorption of niobium and titanium on ammonium and cesium salts of phosphoromolybdenum acid was studied as a function of the solution acidity. A procedure was worked out of concentrating niobium and its separation from titanium. (auth)

14870 EXTRACTION OF Am(III) AND Eu(III) BY A MIXTURE OF TRIOCTYLAMINE AND NEUTRAL EXTRACTANT FROM CHLORIDE SOLUTIONS. Myasoedov, B. F.; Spivakov, B. Ya.; Zolotov, Yu. A.; Kochetkova, N. E.; Shkinev, V. M.; Chmutova, M. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 5, 1379-1384 (May 1974). (In Russian).

The possibility of synergistic extraction of the trivalent transplutonium and rare earth elements from chloride solutions by a mixture of cationic and neutral extractants was studied. Extraction of a mixture of Am and Eu chlorides by trioctylamine (TOA) with tributyl phosphate (TBP) and trioctyl phosphinic oxide from LiCl solution containing different amounts of HCl was investigated. A mixture of TOA and TBP in an inactive diluent extracted Am with a significantly greater distribution coefficient than each of the extractants separately and allowed extraction of Am from comparatively acid solutions. Infrared spectra showed that the synergistic effect is due to extraction by the amine of a composite anion complex containing, in the inner sphere of the metal ion, the chloride ion and molecules of the neutral extractant. (tr-auth)

14871 USE OF REAGENT IM-50 FOR FLOTATION OF RARE-ELEMENT ORES. Dvornichenko, D. I.; Koltunova, T. E.; Kochkin, V. I.; Maksimov, I. I.; Mikhailova, N. S. Tsvetn. Metal.; No. 2, 80(Feb 1974). (In Russian).

In 1972, the use of the reagent IM-50 for enriching secondary quartzites increased the total rare element extraction from this type of ore 15.6% and of yttrium oxide 11.3% compared to 1971 when oleic acid was used in flotation. From quartz-chlorite-sericite and high-grade biotite cherts replacement of oleic acid with reagent IM-50 increased the yields 10% and gave better quality concentrates. The value of the additional recovered materials was estimated as 1100 thousand rubles. (tr-auth)

14872 EXTRACTION OF Mo AND Fe FROM NITRIC AND SULFURIC ACID SOLUTIONS. Zelikman, A. N.; Vol'dman, G. M.; Bulgakov, V. N. Tsvetn. Metal.; No. 2, 55-56(Feb 1974). (In Russian).

Results of studies are presented which show that iron is not extracted from an organic phase (polyalkylphosphonitrilic acid in kerosene) by nitric and sulfuric acids in concentrations of 2 to 6 g-eq/liter. The iron content in the solution tested was 0.2 g/liter or less and decreased with each extraction. Iron was completely removed from the organic phase by treating with a soda solution containing NaOH. The iron hydroxide formed, the soda solution, and the extractant may be recovered. (tr-auth)

14873 SOLVATION OF ALKALINE EARTH HALIDES IN EXTRACTION WITH ISOAMYL ALCOHOL. Kazas, T. S.; Krasnov, K. S. (Ivanovo Chemical Tech. Inst., USSR). Zh. Neorg. Khim.; 19: No. 5, 1375-1378(May 1974). (In Russian).

Solvation of calcium chloride and of calcium and strontium bromides and iodides in the extraction with isoamyl alcohol was studied. The solvate and hydrate numbers in organic phase were determined, and the extraction of the salts in molecular form was calculated. Magnesium chloride, strontium iodide, and all calcium salts were extracted in the hydrated form. The total number of molecules of alcohol and water in the hydro-solvate of calcium halides in the organic phase increased in the order chlorides < bromides < iodides. Strontium chloride and bromide, unlike the iodide, were not hydrated in the organic phase. The extraction constants for calcium and strontium iodides were larger than for the other salts, which apparently explains the tendency of the iodine ion to enter into donor-acceptor interactions with the radical group of the alcohol. (tr-auth)

14874 SEPARATION AND DETECTION OF THORIUM, PROTACTINIUM, AND URANIUM BY HIGH-VOLTAGE PAPER ELECTROPHORESIS. Chang, C. W.; Ting, G. (Inst. of Nuclear Energy Research, Taipei, Taiwan). Nucl. Sci. J. (Taiwan); 8: No. 2, 26-32(Jun 1971).

A rapid and sharp separation of Th, Pa, and U using high-voltage paper electrophoresis was established. Various background electrolytes were examined. The effects of pH and the background electrolyte concentration on the separation were also studied. (auth)

14875 U(VI) EXTRACTION WITH PHENYLSULFONYLAMIDOPHOSPHORIC ACID DIOCTYL ESTER. Shevchenko, F. D.; Malysheva, A. N.; Kuzina, L. A. (Kiev State Univ.). Ukr. Khim. Zh.; 40: No. 3, 277-280(Mar 1974).

U(VI) extraction by benzene solutions of phenylsulfonylamidophosphoric acid dioctyl ester (DOPSAP) was studied as a function of the aqueous phase pH with different DOPSAP concentrations in benzene and different U concentrations in the aqueous phase. At pH 1-3, U(VI) was transferred to the organic phase as UO_2A_2 (A = single-charged anion of DOPSAP). The constant of distribution of the UO_2A_2 complex between benzene and the aqueous phase was $\log P_2 = 3.32$, and the complex formation complex, calculated by a graphical differentiation method, was $\log \beta_2 = 12.60$. The equilibrium constant of the extraction was $K_{ex} = 1.13 \pm 0.03$. (tr-auth)

14876 COUNTER-CURRENT ELECTROPHORETIC SEPARATION OF RARE EARTH METAL IONS WITH IMINODIACETIC ACID. Kreter, R. N.; Miekeley, N. (Pontifica Universidade Catolica, Rio de Janeiro). Mikrochim. Acta; No. 3, 469-473 (1974). (In German).

While 1 N acetic acid is unsuitable for counter-current electrophoretic separation of a mixture of light and heavy rare earth metal ions, a rapid and effective separation can be obtained with iminodiacetic acid (IMDA). The migration velocities of the rare earth metal ions decrease with increasing formation constant of the IMDA-complexes with the sequence Nd > Eu > Ho > Yb. (auth)

14877 DI(N-OCTYL)ARSINIC ACID(HDOAA) AS A REAGENT FOR LIQUID–LIQUID EXTRACTION: EXTRACTION OF SCANDIUM(III), CERIUM(III), EUROPIUM(III), HOLMIUM(III), AND YTTERBIUM(III). Irgolic, K.; Olivares, A. M. (Texas A and M Univ., College Station). Mikrochim. Acta; No. 3, 369-380(1974).

Dioctylarsinic acid, HDOAA, in chloroform solution was investigated as a reagent for the extraction of scandium, cerium, europium, holmium and ytterbium trichlorides. The extraction coefficients reached a maximum of 260 (pH 2), 1.3 (pH 7.6), 6 (pH 7.5), 17 (pH 6.6) and 8 (pH 6.2) for the metal ions in the above order. Each metal ion transfers two hydrogen ions into the aqueous phase upon entering the organic phase. Scandium is complexed to two DOAA anions, two neutral DHOAA molecules and probably a chloride ion and a water molecule. The lanthanide ions are probably in an octahedral environment with two DOAA anions, three HDOAA molecules and a OH or acetate ion serving as ligands. The extraction coefficients for these metal ions are sufficiently different to allow their extractive separation. (auth)

14878 EXTRACTION OF METAL IONS BY AROMATIC SULFOXIDES. II. Solvation of Metal Species in Hydrochloric Acid Systems. Markl, P.; Jettmar, A. A. (Univ., Vienna). Mikrochim. Acta; No. 3, 429-435(1974). (In German).

The present work contains a study of the possibilities of the extraction-chromatographic or the extractive separation that arise from the differing solvation of metal species in dibenzylsulfoxide-HCl and diphenylsulfoxide-HCl system. The R_f-spectra of about 50 ions as determined with inverted phases by means of paper chromatography give a general view regarding the separation possibilities. (auth)

14879 SYNERGISM IN THE SOLVENT EXTRACTION OF SAMARIUM BY 2-THENOYLTRIFLUOROACETONE AND TRIPHENYL- OR TRIOCTYLPHOSPHINE OXIDE MIXTURE. Aly, H. F.; El-Naggar, H. A. (UAR Atomic Energy Establishment, Cairo). Microchem. J.; 18: No. 4, 405-411(1973).

The results of a study carried out with use of $Sm(ClO_4)_3$ enriched in ^{145}Sm and ^{153}Sm show that 0.05 M 2-thenoyltrifluoroacetone (I) or triphenylphosphine oxide in benzene does not appreciably extract Sm from a medium of pH 2 and I = 0.1. However, a benzene solution containing both these compounds gives greatly improved extraction, the optimum concentration being 0.03 M I and 0.02 M triphenylphosphine oxide. Synergism is also observed with use of a mixture of I and trioctylphosphine oxide. The extracted complexes are shown to contain Sm, the ligand of I and the phosphine oxide in the ratio 1 : 3 : 2. Formation constants for these ternary complexes have been determined. (Anal. Abstr.)

14880 PAPER CHROMATOGRAPHY OF LESS COMMON METALS. Separation and Identification of Gold(III), Selenium(IV), and Tellurium(IV) in Solutions Containing Trilon B. Egikyan, R. T.; Gaibakyan, D. S. (Erevan State Univ.). Arm. Khim. Zh.; 26: No. 11, 909-913(1973). (In Russian).

The behavior of Au(III), Se(IV), and Te(IV) was studied by the paper chromatographic method in acidified and ammonium solutions of Trilon B. The effect of the acidity and concentration of the Trilon B solution on the separation of these ions was determined. Some variations in their separation were proposed. (tr-auth)

14881 CONTINUOUS TWO-DIMENSIONAL CHROMATOGRAPHIC SEPARATION OF RUBIDIUM AND CESIUM. Moskvin, L. V.; Mel'nikov, V. A. At. Energ. (USSR); 36: No. 5, 367-369 (May 1974). (In Russian).

Ion-exchange properties of ammonium phosphomolybdate sintered with polytetrafluorethylene in the form of porous block sorbent was investigated. A continuous two-dimensional chromatographic installation using block sorbent to separate rubidium and cesium is described. On the basis of data for the sorption of rubidium and cesium from various salt solutions under static conditions, their continuous two-dimensional separation and concentration of cesium from a sea-water model was performed. The peak maxima agree closely with calculated values. (auth)

14882 USE OF 1-PHENYL-3-METHYL-4-ACYL-5-PYRAZOLONES AS EXTRACTION AGENTS. Navratil, O. (Univ., Brno). Chem. Listy; 68: 470-488(1974). (In Czech).

The article reviews characteristic constants and properties of 1-phenyl-3-methyl-4-acyl-5-pyrazolones and experimental conditions during extraction separation of Ac, Am, Be, Ca, Cd, Ce, Cf, Cm, Co, Cr, Cu, Er, Eu, Te, Gd, Hf, In, La, Mn, Nb, Nd, Ni, Np, Pa, Pb, Pu, Sc, Sr, Ta, Th, Ti, Tl, Tm, U, V, Zn, and Zr with these reagents. (auth)

14883 STUDY OF THE COMPETITION BETWEEN NITRIC AND NITROUS ACIDS AND URANIUM(VI) AND THORIUM(IV) NITRATES IN EXTRACTIONS BY TRIBUTYL PHOSPHATE. Marin, B.; Sellier, J. Y.; Gourisse, D. (Ecole Centrale des Arts et Manufactures, Chattenay-Malabry, France). J. Inorg. Nucl. Chem.; 36: No. 6, 1377-1380(Jun 1974). (In French).

The distribution coefficients of U(VI), Th(IV), and Pu(IV) in the system $H_2O-HNO_3-HNO_2-TBP-$dodecane are explained very accurately by simple calculations. (auth)

14884 EXTRACTION OF MOLYBDENUM, TUNGSTEN, AND RHENIUM BY TRIALKYLBENZYLAMMONIUM CHLORIDE. Chernikova, L. S. Nauch. Tr., Sib. Gos. Nauch.-Issled. Proekt. Inst. Tsvet. Met.; No. 5, 146-155(1972). (In Russian).

Studies were made of the extraction of Mo, W, and Re by the quaternary ammonium salt trialkylbenzylammonium chloride over a wide range of pH and with various salts present. All three metals were well extracted in the pH range 1–4. Re is also almost completely extracted from alkaline solutions thus giving a separation from Mo. However, W and Mo separation is not possible because of the formation of mixed complexes of these metals. Some technical solutions were studied from which 99.99% Mo was extracted at pH 3. (Metals Abstracts)

14885 EXTRACTION–CHROMATOGRAPHIC SEPARATION OF PLUTONIUM. Levakov, B. I.; Timofeev, G. A. Zh. Anal. Khim.; 29: No. 5, 1023-1025(May 1974). (In Russian).

An extraction-photometric procedure was developed for separation of plutonium from transplutonium elements and fission products. Plutonium, oxidized to Pu(VI) with ammonium persulfate in 1 M HNO_3, is sorbed on a column packed with teflon and filled with di-2-ethylhexylphosphoric acid. The transplutonium elements and most rare earths are eluated with 1 M HNO_3 solution. Then Pu(VI) is removed from the column with 5 M HCl solution. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 14930, 14989, 15024, 15060, 15082, 15925, 16146, 16161, 16224, 16332, 16474, 17739, and 18091.

14886 (COO-3429-18) RARE EARTH IONS IN A HEXAGONAL FIELD III. Segal, E.; Wallace, W. E. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1973. Contract AT(11-1)-3429. 24p. Dep. NTIS $4.25.

Energy levels and magnetic moments of rare earth ions in a crystal field of hexagonal symmetry have been obtained using a Hamiltonian of the form, $\mathcal{H} = \mu_B g \vec{J} \cdot \vec{H} + B_2^0 O_2^0 + B_4^0 (O_4^0 + {}^{77}/_5 O_2^0)$. Selected results are presented for all J values appearing in the rare earth series and for values of the parameters covering the situations in which the crystal field is dominant, in which the interaction with the magnetic field is dominant and in which the two interactions are comparable in magnitude. The present treatment is confined to the case in which the magnetic field is directed perpendicular to the hexagonal axis. (auth)

14887 PROCESSING OF Cu–V CAKES TO V_2O_5. Evtyukhov, V. E.; Yaroslavtsev, A. S.; Svyadoshch, I. Yu. Tsvetn. Metal.; No. 2, 52-54(Feb 1974). (In Russian).

A flowsheet is given for diesolving Cu-V cake and processing the solution to a vanadate which is calcined to V_2O_5. (auth)

14888 OXIDATION OF CdI_2 AND PbI_2 IN AN ULTRASONIC FIELD. Popa, N.; Panait, C.; Bellu, D. (Univ. of Bucharest). An. Univ. Bucuresti, Chim.; 22: No. 1, 91-96(1973). (In Rumanian).

One of the most interesting chemical effects produced by ultrasonic fields is the oxidation of inorganic salts in water solution. A study of the oxidation of CdI_2 and PbI_2 at 0.5, 1, and 3 MHz. The maximum yield was obtained at 0.5 MHz. The oxidation yield of CdI_2 is higher than PbI_2. The effect of uranyl nitrate, uranyl acetate, and thorium nitrate on the oxidation of both iodides was studied. The oxidation yields were improved, but not enough to permit conclusions to be drawn. (auth)

Isotope Effects

Refer also to abstracts 14934, 14938, and 15004.

14889 (COO-3498-14) PHASE EQUILIBRIUM ISOTOPE EFFECTS IN MOLECULAR SOLIDS AND LIQUIDS. Vapor Pressures of the Isotopic Carbon Dioxide Molecules. Bilkadi, Z.; Lee, M. W.; Bigeleisen, J. (Rochester Univ., N. Y. (USA). Dept. of Chemistry). 1973. Contract AT(11-1)-3498. 44p. Dep. NTIS $5.25.

The vapor pressures of samples of CO_2 enriched in ^{13}C and ^{18}O were compared with normal CO_2 over the temperature range 154° to 217°K. Over the entire temperature range the order of the vapor pressures is $P_{^{12}C^{16}O_2} > P_{^{13}C^{16}O_2} > P_{^{12}C^{18}O_2}$. The results are explained by the small shift in the internal vibrations, which dominate the carbon isotope effect, and hindered rotation in the solid and liquid. While the isotope effect on melting is small for carbon substitution, it is found to be large for oxygen substitution. Hindered rotation is the major contribution to the oxygen isotope effect in the solid, while the hindered translation is the most important contribution to the oxygen isotope effect in the liquid. Model calculations of the logarithm of the reduced partition function ratios of the solid and liquid, ln(fc/fg), are made in an anharmonic version of the Stern–Van Hook–Wolfsberg cell model. These calculations give good agreement with the experimentally determined ln(fc/fg) values for the solid, liquid-vapor isotope fractionation measurements of Grootes, Mook and Vogel, and lattice dynamic calculations. (auth)

14890 (COO-3498-15) FUNDAMENTAL STUDIES IN ISOTOPE CHEMISTRY. Progress Report, July 1, 1973–June 30, 1974. Bigeleisen, J. (Rochester Univ., N. Y. (USA)). 1974. Contract AT(11-1)-3498. 22p. Dep. NTIS $4.25.

Experimental and theoretical studies are directed toward the establishment and understanding of the relationship between isotope effects and molecular and intermolecular forces. Theory and experiment show that effects arising from isotopic substitution are associated almost exclusively with the molecular and intermolecular forces acting at the site of substitution. Thus isotope effect studies are force probes at the atomic scale. The current experimental program utilizes this property of isotope effects to study liquid structure in simple atomic and molecular fluids. Measurements have been made of the vapor pressures ratios of $^{12}CO_2/^{13}CO_2$ and $C^{16}O_2/C^{18}O_2$ from 154 to 217°K (0.3° above the triple point). The results have been interpreted in terms of the statistical mechanical theory of condensed phase isotope effects. Quantitative agreement is formed between the experimental results and a theoretical calculation of the lattice dynamics of the solid. The latter also confirm inelastic neutron diffraction and infra-red and raman spectra. The contribution of stretching and bending forces to the total deuterium isotope effect in the prototype molecules H_2O, CH_4, CH_2O, C_2H_4, C_2H_2, and C_6H_6 have been calculated as a function of temperature. Remarkable additivity has been found when the basis coordinates used are internal coordinates. This result is explained through the orthogonal polynomial expansion of the reduced partition function ratio developed by Bigeleisen and Ishida. (auth)

14891 PHENOMENOLOGICAL MANIFESTATIONS OF QUANTUM-MECHANICAL TUNNELING. II. Effect on Arrhenius Pre-Exponential Factors for Primary Hydrogen Kinetic Isotope Effects. Stern, M. J. (Yeshiva Univ., New York); Weston, R. E. Jr. J. Chem. Phys.; 60: No. 7, 2808-2814(1 Apr 1974).

The effect of quantum-mechanical tunneling on the Arrhenius pre-exponential factor A_Q in reactions involving primary protium–deuterium kinetic isotope effects was investigated as a function of temperature. It is shown that large tunneling factors can either raise or lower A_Q considerably or leave it essentially unchanged from its value in the absence of tunneling, depending on the details of the reaction system involved and on the temperature range under consideration. Experimental A_Q factors can be used as quantitative indicators of quantum-mechanical tunneling only in conjunction with model calculations. Experimental values of A_Q inside the "no-tunneling" range, $2^{-1} \leq A_Q \leq \sqrt{2}$, do not necessarily indicate the absence of large tunneling factors. (auth)

14892 PHENOMENOLOGICAL MANIFESTATIONS OF QUANTUM-MECHANICAL TUNNELING. III. Effect of Relative Tritium–Deuterium Kinetic Isotope Effects. Stern, M. J. (Univ. of Yeshiva, New York); Weston, R. E. Jr. J. Chem. Phys.; 60: No. 7, 2815-2821(1 Apr 1974).

The effect of quantum-mechanical tunneling on relative tritium–deuterium kinetic isotope effects is investigated with the aid of model calculations. It is shown that even when tunneling is important, such relative effects, defined as $r = \ln(k_H/k_T)\,[\ln(k_H/k_D)]^{-1}$, have values not very different from their values in the absence of tunneling. Thus, for the types of reactions commonly used to investigate tunneling, the limits $1.33 \leq r \leq 1.58$ are not likely to be exceeded. There is no direct general correlation between the magnitude of r and the extent of tunneling, the temperature dependence of r is qualitatively the same for a wide range of reaction models and barrier heights. (auth)

14893 V → T, R ENERGY TRANSFER IN HCl- AND DCl-RARE GAS MIXTURES. Steele, R. V. Jr.; Moore, C. B. (Univ. of California, Berkeley). J. Chem. Phys.; 60: No. 7, 2794-2799 (1 Apr 1974).

Vibrational relaxation rates were measured for HCl and DCl in collisions with the rare gases ^3He, ^4He, Ne, and Ar. For mixtures with ^4He and Ar, data are given between 295 and 700°K. The rates vary approximately linearly with $T^{-\frac{1}{6}}$ indicating that hard collisions cause the relaxation. The value of $P_{HCl\text{-}Ar}/P_{DCl\text{-}Ar} = 2$ is evidence that nearly all of the vibrational energy is transferred into rota-

tion in collisions with Ar. As the mass of the rare gas decreases, $P_{HCl\text{-}M}/P_{DCl\text{-}M}$ decreases. $P_{HCl\text{-}^3He}/P_{HCl\text{-}^4He} = 0.6$. This indicates an increasing importance of translational motion. Substitution of reasonable parameters into a simple theory of V → T, R energy transfer gives qualitatively the same behavior as the experimental results. The wide range of reduced masses, the isotopic substitution of ^3He for ^4He, the comparison of HCl and DCl, and the temperature variation make an ideal set of data for testing more complete theories of V → T, R energy transfer in atom–diatom collisions. (auth)

14894 DISAPPEARANCES OF COOH INFRARED BANDS OF BENZOIC ACID. Hayashi, S.; Umemura, J. (Kyoto Univ.). J. Chem. Phys.; 60: No. 7, 2630-2633(1 Apr 1974).

Infrared spectra of benzoic acid and benzoic acid-d were obtained in the range of temperatures from liquid nitrogen to liquid helium. The C=O stretching band at 1688 cm^{-1}, the strongest absorption band of this compound in the over-all infrared region at room temperature, decreases in intensity with decreasing temperature and disappears near liquid-helium temperatures. Near this temperature, also lost was the band at 959 cm^{-1}, which has been assigned to the OH out-of-plane vibration. For the deuterated species both bands at 1689 and 1679 cm^{-1}, which have been interpreted as splitting due to Fermi resonance of the C=O stretching vibration, were lost. Close to the positions of these lost bands, alternative bands, which are assignable to the same modes and increase in intensity with decreasing temperature, are found. The results support the postulate proposed earlier that two distinct equilibrium configurations of benzoic acid dimer coexist in the crystal. (auth)

14895 DEUTERIUM ISOTOPE EFFECT ON THE RADIATIONLESS DECAY OF THE LOWEST TRIPLET STATE OF A PORPHYRIN FREE BASE. Burgner, R. P.; Ponte Goncalves, A. M. (Pennsylvania State Univ., University Park). J. Chem. Phys.; 60: No. 7, 2942-2943(1 Apr 1974).

The triplet state lifetimes of 1.5×10^{-3}M solutions of meso (mesoporphyrin IX dimethyl ester free base) in 3-methylpentane, C_2H_5OH, and C_2H_5OD at 77°K were 18, 18, and 38 msec, respectively. Since the rate constant for radiative decay, k_r, is negligible for porphyrin free bases, it was assumed that the rate constant for radiationless decay, k_{nr}, equals the reciprocal of lifetime of the triplet state. This leads to $k_{nr}(C_2H_5OH) = 57$ sec^{-1}, $k_{nr}(C_2H_5OD) = 26$ sec^{-1}. The large isotope effect could result from two contributions: a decrease in the direct relaxation and a decrease in the rate of tautomerism due to the deuteration of the N-H hydrogen. (MCG)

14896 ROTATIONAL ANALYSIS OF ν_6 OF DCF_3 AND $\nu_3 + \nu_6$ OF HCF_3. Lockett, P.; Wilt, P. M. (Centre Coll., Danville, KY). J. Chem. Phys.; 60: No. 8, 3203-3209(15 Apr 1974).

Experimental data of moderately high resolution for the "pseudo-parallel" bands ν_6 of DCF_3 and $\nu_3 + \nu_6$ of HCF_3 are reported. Analysis of ν_6 is straightforward and results in values of ν_0, α_6^C and the conclusion that $q_6 > 0$. $\nu_3 + \nu_6$ is perturbed by Fermi resonance with ν_3. Analysis in this case yields values of ν_0, $\alpha_{3,6}^C$, the anharmonic potential constant $|k_{336}|$ and the conclusion $q_6 > 0$. The effect of this Fermi resonance on the J = 1 ← 0 pure rotational spectrum of HCF_3 is discussed. (auth)

14897 FORMATION OF CHROMIUM DEUTERIDE FROM METALLIC CHROMIUM AND HIGH PRESSURE GASEOUS DEUTERIUM. Baranowski, B.; Tkacz, M. (Inst. of Physical Chemistry, Warsaw). Rocz. Chem.; 48: No. 4, 713-714(1974).

Chromium deuteride was obtained from foils of metallic chromium and high pressure deuterium. The more or less discontinuous increase of the electrical resistance was taken as the first criterion of the formation of chromium deuteride. A rapid increase of resistance indicating a phase transition was observed in the pressure range 18,000–18,500 at. A considerable difference in the kinetics of formation of CrH and CrD was observed. (LK)

14898 DEUTERIUM ISOTOPE EFFECT ON SPIN-FORBIDDEN TRANSITIONS. Bhattacharjee, H. R. Detroit; Wayne State Univ. (1973). University Microfilms.

Thesis (Ph. D.)

The spin-forbidden singlet ⇝ triplet transitions (intersystem crossing) in aromatic molecules and the deuterium isotope effects on such transitions are investigated and discussed with experimental details in this work. It has been shown that the rate of the singlet ⇝ triplet intersystem crossing in anthracene and pyrene in different solvents are enhanced, rather than retarded, by deuteration of the molecule. This inverse isotope effect on the intersystem crossing is interpreted as arising from the participation of one or more higher triplet states (particularly T_3) in the radiationless transitions. Replacements of hydrogen by deuterium in aromatic compounds result in increased phosphorescence lifetime and quantum yield. The lack of large deuteration effect in the fluorescence of aromatic hydrocarbons is attributed to the small energy gaps between the lowest excited singlet and triplet, (including the lowest) states. The enhancement of phosphorescence quantum yield and lifetime upon deuteration is attributed to the slowing down of the $T_1 \rightsquigarrow S_0$ non-radiative decay resulting from the concomitant decrease of the Franck-Condon overlap density. This effect is expected to be negligible for electronic energy gap smaller than typical C-H frequency and to be enhanced for the increasing energy gap. (LK)

14899 DETERMINATION OF THE DENSITY OF THEORETICAL PLATES AND THE MASS EFFECT IN COUNTERCURRENT ELECTROPHORESIS. Freyer, H. D. (Nuclear Research Center, Juelich, Ger.). J. Chromatogr.; 91: 853-865(24 Apr 1974).

From 4th international symposium on advances and utilization of chromatography; Bratislava, Czechoslovakia (25 Sep 1973).

The density of theoretical plates, $n(cm^{-1}) = \nu_L/D_{eff}$, in a countercurrent electrophoretic column is given by the effective diffusion coefficient, D_{eff}, of the ions and the flow rate, ν_L, of the countercurrent solution. Both values and the dependence on each other have been measured. The mass effect, $1 + \epsilon$, based on the differences in ionic mobilities, was determined for the isotope mixture $^{22}Na-^{23}Na$ in 1 N acetic acid as the countercurrent solution as a function of the ionic concentration. It was found that experimentally determined separation factors, $Q = (1 + \epsilon)^{n \cdot x}$, obtained in the stationary state of the process, are in good agreement with those calculated from the measured values of n and $1 + \epsilon$. (auth)

14900 ROLE OF DEUTERIUM IN VIBRATIONAL ANALYSIS OF MOLECULES WITH TRIPLE BONDS. Phibbs, M. K.; Robinson, D. G. (Du Pont of Canada Ltd., Kingston, Ont.). Can. J. Spectrosc.; 19: No. 1, 29-31(Jan 1974).

Normal coordinate analysis of molecules containing (≡C–H) bonds (hydrogen cyanide and acetylene) and their deuterium analogues reveals that the force constant for C–D is significantly higher than for C–H when optimized anharmonic force fields are calculated. The size of this difference has been estimated and should be applicable to analysis of more complex molecules containing the (≡C–H) group. (auth)

14901 ACTIVITY COEFFICIENTS OF 1–1 ELECTROLYTES IN HEAVY WATER (^2H_2O). Marshall, P. R.; Katz, J. J. (Argonne National Lab., IL). J. Inorg. Nucl. Chem.; 36: No. 7, 1589-1594 (Jul 1974).

Activity coefficients of NaCl, KCl, Li, Na and K acetates, and Li, Na and K hydroxides have been measured relative to $ZnSO_4$ in H_2O and $^2H_2O(D_2O)$ by an isopiestic method. (auth)

14902 REACTION OF TRICHLOROMETHYL RADICALS WITH BROMOMETHANES AND DEUTERATED BROMOMETHANES. Primary Isotope Effect. Hautecloque, S. (CNRS, Orsay, France). J. Chim. Phys.; 71: No. 1, 13-17(Jan 1974). (In French).

Comparisons are made between the different parameters associated with the extraction of H from CH_4, CH_3Br, CH_2Br, and $CHBr_3$ using CCl_3 radicals in the 215 to 300°C temperature range. Activation energy differences are explained in terms of enthalpy changes and polar effects. The kinetic isotope effect is studied for each reaction: the decrease in the k_H/k_D ratio is apparently related to enhanced polar effects. (FR)

14903 OXYGEN ISOTOPE EFFECTS AND HYDRATE STRUCTURE OF ALKALI HALIDE SOLUTIONS IN H_2O AND D_2O. Goetz, D.; Heinzinger, K. (Max-Planck-Institut fuer Chemie, Mainz). Z. Naturforsch.; 28A: No. 2, 137-141(Feb 1973). (In German).

The fractionation of oxygen isotopes in solutions of LiCl, NaCl, KCl, KBr, KI, and CsCl with H_2O and D_2O as solvent was measured at 25°C by means of the CO_2-equilibration technique. As opposed to earlier measurements, a slight anion dependence for the potassium halides has been found in H_2O. This anion effect is much more pronounced in D_2O. It even leads to a change in the directions of the ^{18}O enrichment between cationic hydration water and bulk water for KCl and KBr. The absolute values of the fractionation factors for LiCl and CsCl, which differ in sign in H_2O in agreement with positive and negative cationic hydration, respectively, as known from other kinds of measurements, is increased for LiCl and decreased for CsCl in D_2O. There is no fractionation of the oxygen isotopes between hydration water and bulk water in both solvents for NaCl. The solvent isotope effect is explained by the stronger anion influence on the structure of the bulk water in D_2O as compared with H_2O. This stronger influence is expected because of the higher structural order in D_2O than in H_2O at the same temperature. (GE)

14904 THEORETICAL STUDY OF THE DEUTERIUM ISOTOPE EFFECT ON THE ASSOCIATION OF CARBOXYLIC ACIDS.

Hughes, T. P. New Brunswick, NJ; Rutgers–The State Univ. (1973). 163p. University Microfilms Order No. 74-8790.

Thesis (Ph. D.).

The deuterium isotope effect on the association of formic and acetic acid is calculated for the deuterated analogues of HCOOH and CH_3COOH using the ideal gas harmonic approximation. In order to perform these calculations, a normal coordinate treatment for formic acid dimer is carried out, and a Urey–Bradley force field is evaluated for the dimer. The calculations for acetic acid are based on recently reported potential functions. The dimerization constants of the isotopic species differ considerably from each other. At room temperature, carboxylic acid dimers deuterated at the carboxyl position are shown to be more stable, and acid dimers deuterated at the hydroxyl position or completely deuterated dimers are found to be less stable, than the protonated dimer. The calculated isotope effects on dimerization are correlated with the structures, i.e., the geometries and the force fields, of the monomeric and the dimeric species. The isotope effect on the heat of dimerization, which is essentially the isotopic difference of the zeropoint energy change on dimerization, is shown to originate from opposing contributions of the hydroxyl bond stretching and the librational modes. The isotope effect on the entropy of dimerization is interpreted in terms of rotational contributions and contributions due to excitation of vibrational modes of the dimer which arise from coupling between librations and intramonomer torsions. Recently observed isotope fractionations for the catalytic exchange between hydrogen gas and carboxylic acids in the pure liquid state and in nonpolar solutions according to $RCOOH_{(l)} + HD_{(g)} = RCOOD_{(l)} + H_{2(g)}$ are compared with theoretical fractionation factors using the isotopic partition function ratios of the monomer and dimer, reported here. The calculated values are considerably higher than the observed isotope fractionations. Satisfactory agreement is obtained after a correction is applied which is due to anharmonic coupling between the hydroxyl bond stretching and the hydrogen bond stretching vibrations of the dimer. (diss. abstr. int., B)

14905 ISOTOPIC EFFECTS IN ACCIDENTAL PREDISSOCIATION. The Case of the $C^2\Sigma_u^+$ State of N_2. Lorquet, A. J.; Lorquet, J. C. (Liege Univ. (Belgium). Inst. de Chimie). Chem. Phys. Lett.; 26: No. 1, 138-143(1 May 1974).

The large isotopic effect recently found in the decay of the $C^2\Sigma_u^+$ state of N_2^+ is interpreted by an indirect (accidental) predissociation mechanism. The $C^2\Sigma_U^+$ state interacts with a bound intermediate state, itself predissociated by a repulsive state. The competition between fluorescence and predissociation is controlled by the energy difference separating adjacent levels of the two bound states. This energy difference will be different for each vibrational level of each isotope. Fluorescence and predissociation rate constants are given for each level, and the position of the intermediate bound state is fitted to a Morse potential. (auth)

14906 MOLECULAR ISOTOPE EFFECTS IN THE THERMAL-ENERGY CHARGE EXCHANGE BETWEEN He^+ AND N_2. Govers, T. R.; Fehsenfeld, F. C.; Albritton, D. L.; Fournier, P. G.; Fournier, J. (National Oceanic and Atmospheric Administration, Boulder, Colo. (USA). Environmental Research Labs.). Chem. Phys. Lett.; 26: No. 1, 134-137(1 May 1974).

The N^+ and N_2^+ products of the thermal-energy reaction of He^+ with $^{14}N_2$ and $^{15}N_2$ have been examined by mass spectroscopy and the emission from the product $C^2\Sigma_u^+$ state of $^{14}N_2^+$ and $^{15}N_2^+$ has been investigated by optical spectroscopy. A strong isotope effect is observed in both the N^+/N_2^+ ratio and the optical emission. Lower limits are placed on the production of excited N_2^+ states other than the $C^2\Sigma_u^+$ state. (auth)

14907 DEUTERIUM ISOTOPE EFFECTS IN THE SOLVOLYTIC REACTIVITY OF SIMPLE ALKYLVINYL TRIFLUOROMETHANE-SULPHONATES. Stang, P. J.; Hargrove, R. J.; Dueber, T. E. (Utah Univ., Salt Lake City). J. Chem. Soc., Perkin Trans., II; No. 7, 843-847(1974).

The kinetic as well as product deuterium isotope effects were measured in the solvolysis of (A) 1-trideuteriomethyl-2-methylprop-1-enyl, (B) cis-, and (C) trans-2-deuterio-1-methylprop-1-enyl trifluoromethane-sulphonates as well as the (D) 3,3,3-trideuterio-1-methyl-2-trideuteriomethylprop-1-enyl ester. At 75°C in aqueous 60% enthanol for (A) $k_H/k_D = 1.54$, for (B) 1.25, for (C) 2.01, and for (D) 0.96. The significance of these results are discussed. (auth)

14908 NUCLEOPHILIC DISPLACEMENTS UPON PHENYL ESTERS IN WHICH THE DIRECT RELATIONSHIP BETWEEN BASICITY OF THE LEAVING GROUP AND RATE IS DETERMINED BY GROUND STATE CONFORMATIONS. A Question of Concerted Catalysis in the Hydrolysis of Hexachlorophene Esters. Bruice, T. C.; Oka, I. (Univ. of California, Santa Barbara). J. Amer. Chem. Soc.; 96: No. 14, 4500–4507(10 Jul 1974).

The log of the rate constants ($\log k_{rate}$) for specific acid and specific base catalyzed hydrolysis, aminolysis, and intramolecular carboxyl anion nucleophilic catalysis of hydrolysis of the hexachlorophene esters I–V is linearly related to the pK_a values of the conjugate acids of the leaving phenolate moieties ($\log k_{rate} = -\alpha pK_a + C$). The values of α are ca. 1.0 for specific acid and base catalyzed hydrolysis and ca. 0.2 for aminolysis and carboxyl anion catalyzed hydrolysis. Thus, sensitivity to the basicity of the leaving group is great ($\alpha \cong 1.0$) for those reactions in which departure is not rate limiting but minimal ($\alpha \cong 0.2$) for those reactions in which departure is rate limiting. The direct relationship between leaving ability and rate must, therefore, be dependent on a third factor that controls both. This factor is suggested to be the like ground state conformations of esters and phenols. The conformations allowing maximal internal hydrogen bonding in phenol (VII and IX), which provide for a ΔpK_a of 5 also provide for minimal and maximal steric hindrance to approach of nucleophile to the ester bond. The hydrolysis of hexachlorophene monosuccinate (III), characterized by a "bell shaped" pH-log k_{rate} profile, does not, as previously claimed, involve a push-pull catalytic mechanism consisting of carboxyl anion nucleophilic attack plus general acid catalysis by the phenolic group (XIII). Thus, methylation of the phenolic group of III to provide IV decreases the rate of carboxyl anion attack by but 3.2-fold. This is due to steric hindrance by the methyl substituent. Much larger steric effects accompanying methylation of the phenolic group are seen on comparing the rate constants for specific acid catalyzed hydrolysis of III vs. IV (k_{rel} 1 : 1/29) and the corresponding acetyl esters I vs. II(k_{rel} 1 : 1/149). (auth)

14909 HYDROLYSIS OF α-METHOXYSTYRENES. A Molecular Orbital-Perturbation Analysis of Substituent Effects and the Relationship Between Hydration and Solvolysis Reactions. Loudon, G. M.; Berke, C. (Cornell Univ., Ithaca, NY). J. Amer. Chem. Soc.; 96: No. 14, 4508-4517(10 Jul 1974).

Rates of hydration of para-substituted α-methoxystyrenes, a reaction believed to proceed through carbonium ion intermediates, show a systematic downward curvature when correlated by σ^+ but a fair correlation against σ values. This behavior is not due to a change in rate-determining step, nor can it be viewed as equivalent to a curved Brønsted plot. Substituent effects were examined in the hydration reactions of various α-substituted styrenes with the Yukawa–Tsuno relation, and as the electron-donating character of the α substituent is increased, an increasingly less negative ρ is accompanied by a progressively smaller r parameter; the hydrolysis of α-methoxystyrenes is an extreme case of this behavior, and the small r value for this reaction leads to the observation of downward curvature in the σ^+ correlation. The hydrolysis of α-acetoxystyrenes represents a deviation from the relationship of ρ and r, and possible reasons for this observation are discussed. Extended Hückel calculations show that the relationship between ρ and r in hydration reactions is theoretically reasonable, and perturbation arguments reveal that the decreased "resonance interaction" of substituents in the para position in styrenes substituted in the α position with electron-donating substituents is due to the perturbation to significantly higher energies of the lowest unoccupied molecular orbital (LUMO) of the 1-phenylethyl cation (as a model for the transition state of the hydration reaction) by the α substituent. Similar perturbation arguments explain why hydration reactions are less sensitive to substituent effects than solvolysis reactions leading to the same first intermediate carbonium ion. The observation of "saturation effects" in substituent-induced perturbations is given theoretical support through these arguments. (auth)

14910 KINETICS AND THERMODYNAMICS OF LANTHANIDE SULFATE ASSOCIATION IN DEUTERIUM OXIDE. Farrow, M. M. Stillwater, OK; Oklahoma State Univ. (1973). 85p. University Microfilms Order No. 74-8005.

Thesis (Ph. D.).

An ac conductivity bridge was used to determine the association constant for some lanthanide (III) sulfate complexes in deuterium oxide. A square wave pulsed ultrasound generator was then used to obtain the ultrasonic relaxation spectra over the frequency range 5 to 65 MHz for the ions Pr(III), Sm(III), Gd(III), and Dy(III) at 25°C. The ultrasonic absorption was also measured for Sm(III) in 0.5 and 0.75 M $NaClO_4$ solution. From this information the stepwise rate constants were determined. The formation constants in D_2O were found to be within experimental error of the recalculated values in H_2O. The rate constants were determined to be within experimental error of the recalculated of the H_2O values. This lack of a solvent isotope effect is taken to support the D mechanism for the association of ions. Although the rate constants varied with ionic strength in accordance with the Bronsted-Debye-Hückel theory, the change in the rate constants was not large enough to

account for the differences in rates determined by ultrasonic methods and those determined by transient methods. This result was taken to imply the possibility of chelation in the reactions studied by transient methods. (Diss. Abstr. Int., B)

14911 RATE MEASUREMENTS OF REACTIONS OF OH BY RESONANCE ABSORPTION. Pt. 3. Reactions of OH with H_2, D_2, and Hydrogen and Deuterium Halides. Smith, I. W. M.; Zellner, R. (Cambridge Univ., Eng.). J. Chem. Soc., Faraday Trans., II; 70: No. 6, 1045-1056(1974).

The rates of the reactions of OH with H_2, D_2, HCl, and DCl were determined between 210 and 460°K using time-resolved resonance absorption to monitor removal of OH following creation of the radicals by flash photolysis of mixtures containing H_2O or N_2O + H_2. Arrhenius rate laws are obeyed by all four of these reactions throughout this range of temperature: $k_{OH+H_2} = 1.8 \times 10^{-11}$ exp [−19.4 kJ mol^{-1}/RT] cm^3 molecule^{-1} s^{-1}; $k_{OH+D_2} = 1.2_5 \times 10^{-11}$ exp [−21.5 kJ mol^{-1}/RT] cm^3 molecule^{-1} s^{-1}; $k_{OH+HCl} = 4.1 \times 10^{-12}$ exp [−4.4 kJ mol^{-1}/RT] cm^3 molecule^{-1} s^{-1}; and, $k_{OH+DCl} = 4.7 \times 10^{-12}$ exp [−6.5 kJ mol^{-1}/RT] cm^3 molecule^{-1} s^{-1}. The observed kinetic isotope effects are compared with predictions based on 3- and 4-atom models of the transition states using semi-empirical potential functions to estimate the transition state properties. Preliminary measurements on the reactions of OH with HBr and HI are also reported. The rate constants at 298°K are respectively 4.5×10^{-12} and 9×10^{-12} cm^3 molecule^{-1} s^{-1}. (auth)

14912 MODEL CALCULATIONS OF KINETIC ISOTOPE EFFECTS IN NUCLEOPHILIC SUBSTITUTION REACTIONS. Bron, J. (Univ. of Natal, Durban, South Africa). Can. J. Chem.; 52: No. 6, 903-909(15 Mar 1974).

The results of calculations indicate that a previously proposed model for the transition state in "borderline" substitution reactions can be generalized and, as a result, the observed differences in the ^{13}C and deuterium isotope effects of S_N1, S_N2, and "borderline" reactions rationalized. Although the conclusions may apply more generally, the standard reaction investigated is the solvolysis of benzyl bromide. The importance of resonance interaction with the phenyl ring, the significance of the product- or reactant-like character of the transition state, and the influence of the magnitude of force constants in determining isotope effects are examined. The temperature dependence of kinetic isotope effects in solvolysis is also investigated. (auth)

14913 RELAXATION ATTENUATION OF ULTRASOUND IN NORMAL AND DEUTERATED ROCHELLE SALT. Minaeva, K. A.; Huoang Chung Thu; Strukov, B. A.; Velichko, I. A.; Koptsik, V. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 6, 674-679 (1973). (In Russian).

A comparative study was made of the absorption coefficient of longitudinal ultrasonic waves as a function of the temperature at frequencies of 10, 30, and 50 MHz for normal and deuterated Rochelle salt near the lower and upper Curie point. At the limits of the scattering of experimental points from sample to sample the relaxation time for normal and deuterated Rochelle salt coincides. The difference in the character of the abnormal absorption coefficient for waves being propagated in different crystallographic directions was discussed. (tr-auth)

14914 STUDIES ON NITROGEN IODINE COMPOUNDS. X. The IR Spectra of $NI_3 \cdot 3NH_3$ and $NI_3 3ND_3$ in the Region of N−I Fundamental Vibrations. Jander, J.; Minkwitz, R. (Univ., Heidelberg). Z. Anorg. Allg. Chem.; 405: No. 3, 250-256(May 1974). (In German).

The IR spectra of $NI_3 \cdot 3NH_3$ and $NI_3 \cdot 3ND_3$ are similar to those of $(NI_3 \cdot NH_3)_n$ and $(NI_3 \cdot ND_3)_n$, respectively. Especially the positions of the N−I vibrations are identical. From these results it is allowed to conclude that $NI_3 \cdot 3NH_3$ shows a N−I scaffold similar to the well known N−I scaffold of $(NI_3 \cdot NH_3)_n$. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 17384.

14915 SPECTRA AND STRUCTURE OF BORON−NITROGEN COMPOUNDS. II. Infrared and Raman Spectra of Trimethylamine−Borane. Odom, J. D.; Barnes, J. A.; Hudgens, B. A.; Durig, J. R. (Univ. of South Carolina, Columbia). J. Phys. Chem.; 78: No. 15, 1503-1509(18 Jul 1974).

The infrared (33−4000 cm^{-1}) and Raman (0−3500 cm^{-1}) spectra of $(CH_3)NBH_3$, $(CH_3)_2NBD_3$, $(CD_3)_2NBH_3$, and $(CD_3)_2NBD_3$ have been recorded for the solid state at low temperatures. The spectra have been interpreted in detail on the basis of C_{3v} molecular symmetry. The valence force field model has been utilized in calculating the frequencies and potential energy distribution. The calculated potential constants for the adduct are compared to those previously reported for the Lewis base moiety. The N−B stretch was found to be extensively mixed with the N−C symmetric stretch. Nevertheless, the Raman bands at 680, 660, 641, and 610 cm^{-1} for the $(CH_3)_2NBH_3$, $(CH_3)_2NBD_3$, $(CD_3)_2NBH_3$, and $(CD_3)_2NBD_3$ molecules, respectively, have been shown to be approximately 65% or more N−B stretching motion. The N−B force constant was found to have a value of 2.59 mdyn/Å which seems consistent with adduct stability. CNDO/2 calculations were carried out to calculate the barrier to internal rotation of the BH_3 group, the dipole moment, and the N−C force constant. (auth)

14916 KINETICS AND MECHANISM OF ISOPROPYL ALCOHOL DEHYDROGENATION ON NICKEL CATALYST IN VAPOR PHASE. Gegenava, T. P.; Kiperman, S. L. (Inst. of Organic Chemistry, Moscow). Soobshch. Akad. Nauk Gruz. SSSR; 74: No. 3, 613-616(Jun 1974). (In Russian).

A complex investigation of isopropyl alcohol dehydrogenation in the reversibility region on nickel was studied involving the reaction kinetics data, determination of kinetic isotopic effects, and investigation of isotopic exchange in the course of the reaction. The isotopic distribution was analyzed by means of mass, NR, and NMR spectrometry. A kinetic equation corresponding to a two-way reaction scheme was derived. The reaction mechanism is suggested on the basis of the data obtained. (auth)

14917 RELATION BETWEEN D/H AND T/H ISOTOPIC FRACTIONATION IN SOME REACTIONS OF CHEMICAL INTEREST. Weston, R. E. Jr. (Brookhaven National Lab., Upton, NY). Z. Naturforsch., a; 28: No. 2, 177-184(Feb 1973).

Reduced partition functions for deuterium- and tritium-substituted H_2O, H_2S, H_2Se, NH_3, PH_3, AsH_3, CH_3OH, CH_3SH, HCCH, CH_3CCH, and $HCONH_2$ have been calculated over the temperature range 100 to 1,000°K. Isotopic fractionation factors for the exchange of these molecules with H_2O have also been computed, and a comparison with experiment is made. The correlation between tritium and deuterium isotope effects is discussed. (GE)

14918 INVESTIGATION OF THE GAS-SOLID INTERFACE REACTION. Katsumoto, M.; Fueki, K.; Mukaibo, T. (Tokyo Univ.). Bull. Chem. Soc. Jap.; 46: No. 12, 3641-3644(Dec 1973).

The isotopic exchange between H_2S and D_2 on molybdenum disulfide and manganese sulfide has been studied kinetically between 420 and 500°C. The reaction proceeded via these steps: $H_2S + D_2 = D_2S + H_2$ and $H_2 + D_2 = 2$ HD. From the analysis of the kinetic data, the rate constant of the sulfurization of both metal sulfides by "hydrogen sulfide," k_i, and that of their reduction by "hydrogen," k'_i, were calculated. The dependence of these rate constants on the sulfur activity was determined. A possible mechanism of the reaction at the surface of the sulfides is discussed. (auth)

14919 THEORETICAL ANALYSES OF ISOTOPE-EXCHANGE REACTIONS. I. Lithium and Calcium Isotopes. II. Isotopic Water Vapors and Alkali Metal Mirrors. Liu, Tung-Sheng. Davis, CA; University of California (1973). 136p. University Microfilms Order no. 74-8521.

Thesis (Ph. D.).

Statistical mechanical methods were applied to calculations of equilibrium constants and thermodynamic functions with various levels of approximation using, for solids, Einstein and Debye theories, and, for gases harmonic-oscillator and rigid-rotor, anharmonic-oscillator and nonrigid rotor, and anharmonic-oscillator-nonrigid rotor with the Wolfsberg zero-point energy correction. The first analysis was made on the ^6Li- ^7Li and ^{40}Ca-^{48}Ca isotope-exchange reactions of the following types: $^7Li_{(s)} + {}^6LiX_{(g)} = {}^7LiX_{(g)} + {}^6Li_{(s)}$, $^7Li_{(s)} + {}^6LiX_{(s)} = {}^7LiX_{(s)} + {}^6Li_{(s)}$, $^{48}Ca_{(s)} + {}^{40}CaX_{2(g)} = {}^{48}CaX_{2(g)} + {}^{40}Ca_{(s)}$, and $^{48}Ca_{(s)} + {}^{40}CaX_{(g)} = {}^{48}CaX_{(g)} + {}^{40}Ca_{(s)}$ where X = F, Cl, Br, or I. Comparison of calculated results with experimental results of reactions in various phases confirms the capability of using gas phase halides as prototype reactions for those in solution phase, loosely correlated to the dissociation extent of lithium halide. In all solid phase reactions, the use of the square root inverse reduced-mass-ratio relation resulted in a rather high equilibrium constant relative to those of solid-gas and solid-solution phase reactions, whereas the use of the square root inverse simple-mass-ratio formulas gave a relatively low value (K < 1.0). An experimental method for carrying out the reaction in electrochemical cells was proposed to clarify the validity of these two approximations. Equilibrium constants for the reactions involving $LiX_{(s)}$ and $Ca_{(s)}$ were found to be insensitive to the models of solids used and the temperature. The second analysis was directed at the hydrogen-isotope fractionation effect and the mass action expression $Q = [HD]^2/([H_2] \cdot [D_2]) = 12.0 \pm 2.6$, which were observed by Volman and Bremner in reactions of isotopic water vapors with alkali metal mirrors. Calculation of the equilibrium constant for the reaction of $H_2O_{(g)} + MOD_{(s)} +$

$\frac{1}{2}\ D_{2(g)} = D_2O_{(g)} + MOH_{(s)} + \frac{1}{2}\ H_{2(g)}$ (M = alkali metal) shows the applicability of illustrating the fractionation order (Na ≈ K < Li < R_b ≈ C_s) for the enrichment of protium in the gas phase in terms of a thermodynamic isotope effect. To explain the value of Q, we have treated the following model proposed by Bremner: 1. Collision of water vapor with alkali metal yields metal hydroxides and equilibrium mobile and immobile surface hydrogen atom. 2. Exchange of water with metal hydroxide favors the conversion of HOH to HOD and HOD to DOD and retards the fractionation effect arising from a primary kinetic effect which favors the formation of the MOD bond in the HOD and alkali metal reaction. 3. Hydrogen gas is formed by the collision of diffusing mobile atoms with stationary atom to yield a linear activation complex. From a combination of rate theory and equilibrium statistical thermodynamics we have found that conformance with the experimental results (Q ≈ 12) requires adatoms with unreasonably high zero-point energy. (diss. abstr. int., B)

14920 ON THE HETEROGENEOUS ISOTOPIC EXCHANGE BETWEEN IODINE ADSORBED ON RHODIUM AND SOME ALKYL IODIDES. Toth, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Radiochim. Acta; 19: No. 2, 62-65(1973).

7 figs.; 1 tab.; 8 refs.

The kinetics of isotopic exchange between iodine adsorbed on rhodium and methyl, ethyl, n-propyl, and n-butyl iodide were investigated. The time dependence of the fraction exchange (1-F) varies with time similarly as it does in an aqueous solution of I_3^- ions. The minimum activation energy of the exchange (i.e., the activation energy for the least firmly bound adsorbed iodine atoms) was calculated from an Arrhenius plot. As expected, the activation energies were considerably lower than those for the corresponding homogeneous exchange processes, which can be explained by the fact that iodine of the adsorbed monolayer is already in the atomic state, thereby saving the 36 kcal/mole dissociation it requires in most solvents. (GE)

14921 HYDROGEN ISOTOPE EXCHANGE BETWEEN NITROBENZENE AND SODIUM BOROHYDRIDE. Gold, V.; Nowlan, V. (King's Coll., London). J. Chem. Soc., Chem. Commun.; No. 12, 482-483(19 Jun 1974).

Reaction between tritium-labelled sodium borohydride and nitrobenzene in dimethyl sulfoxide solution at 25°C leads slowly to tritium incorporation into nitrobenzene, with the implication of reversible hydride (tritide) transfer between the reactants. (auth)

14922 TRANSITION METAL CATALYZED EXCHANGE OF DEUTERIUM GAS WITH TERMINAL BORON–HYDROGEN BONDS IN CARBORANES, METALLOCARBORANES, AND OTHER BORON COMPOUNDS. Hoel, E. L.; Hawthorne, M. F. (Univ. of California, Los Angeles). J. Amer. Chem. Soc.; 96: No. 14, 4676-4677(10 Jul 1974).

A number of group VIII hydrogenation catalysts will effect the exchange of deuterium gas with terminal B–H bonds in a wide variety of boron compounds, including carboranes, metallocarboranes, and boron hydrides. The preliminary results of selected catalytic deuterations using $(PPh_3)_3RuHCl$ and $(PPh_3)_3(CH_3CN)RuHCl$, two of the more effective catalysts, were tabulated. Comparisons of different catalysts with $1,2\text{-}C_2B_{10}H_{12}$ as the constant substrate were made. Both homogeneous and heterogeneous active catalysts have been found, although the homogeneous catalysts are more effective and selective. The order of rates of deuterium incorporation at the four chemically nonequivalent sets of sites at the B atoms but not at the H atoms was followed. None of the catalysts caused exchange at the carbon atoms and no exchange was noted for the bridge hydrogens of $B_{10}H_{14}$. The correlation of the pattern of reactivity for these deuterations with patterns of nucleophilic substitution is in accord with a mechanism involving oxidative addition of a transition metal complex to a terminal B–H bond. (JSR)

14923 KINETICS OF HYDROGEN ISOTOPE-EXCHANGE REACTIONS. Pt. 25 pH-Dependence of Aromatic Exchange Initiated by Photolysis of Aqueous Potassium Iodide Solutions. Gold, V.; Major, M. A. (King's Coll., London). J. Chem. Soc., Faraday Trans., I; 70: 977-984(1974).

The aromatic tritium exchange reaction brought about by the action of light on iodide solutions containing tracer tritium and dissolved benzene is shown to depend on the acidity of the solution, falling off to a lower value at high pH. This behavior is consistent with the existence of two exchange routes, one initiated by hydrogen (tritium) atoms and one by solvated electrons. The latter route assumes prominence only when insufficient hydrogen ions are present to compete effectively with benzene for solvated electrons. The effect of added nitrous oxide and nitrate ions is quantitatively consistent with the action of these species as electron scavengers. (auth)

14924 KINETICS OF HYDROGEN ISOTOPE EXCHANGE REACTIONS. Pt. 24. Exchange Between Benzene and Water Initiated by Photolysis of Potassium Iodide Solutions. Gold, V.; Major, M. A.; Gregory, M. J. (King's Coll., London). J. Chem. Soc., Faraday Trans., I; 70: 965-976(1974).

The action of light (253.7 nm) on solutions of potassium iodide and benzene in acidified tritium-containing water is shown to lead to tritium uptake by benzene. Systematic investigation of the exchange leads to the conclusion that the exchange is induced by hydrogen (tritium) atoms which are generated in the system by reaction of solvated electrons with hydrogen ions, the electrons being produced from iodide ions on light absorption. (auth)

14925 TITANIUM ISOTOPES SEPARATION BY DISTILLATION OF TITANIUM TETRACHLORIDE. Panchenkov, G. M.; Gorokhov, L. N.; Timofeev, E. M.; Tsimmerman, V. D. Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 2, 197-200(1974). (In Russian).

Distillation techniques were applied to the separation of titanium isotopes; titanium tetrachloride was used as an operating agent. After a two week period of continuous operation of the 170 cm long distillation column, the enrichment coefficient increased to 1.09. (auth)

14926 EFFECT OF IODINE CONCENTRATION ON FUNCTIONING OF ISOTOPE-EXCHANGE COLUMNS. Nakhutin, I. E.; Rubezhnyi, Yu. G. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 10, 1487-1489(Oct 1973).

Translated from Zh. Fiz. Khim.; 47: No. 10, 2648-2652(Oct 1973).

A theoretical calculation is made for isotope exchange columns. The concentration distribution of radioactive iodine along the column and its dependence on the column parameters and on the gas flow are calculated. The distribution of iodine and the purification coefficient are shown to depend on the quantity of impregnant introduced into the column and also, in contrast to adsorption columns, to depend significantly on the concentration of radioactive iodine in the gas flow. The dependence of the above quantities on the disintegration constant is complicated in character. (auth)

14927 SOLVENT MODIFICATION OF PLATINUM AND PALLADIUM CATALYZED HYDROGENATION, EXCHANGE AND ISOMERIZATION OF ALKENES. Klotz, M. R. Carbondale, IL; Southern Illinois Univ. (1973). 142p. University Microfilms Order No. 74-6270.

Thesis (Ph. D.).

The study of olefin hydrogenation over precious metal catalysts with deuterium (deuteriumation) has provided a new interpretation of the solvent effect for the hydrogenation of olefins. This interpretation utilizes a molecular model of the substrate and solvent molecules coadsorbed on the catalyst surface. The substrate is initially diadsorbed on the catalyst surface and is considered to undergo reduction by the Horiuti–Polanyi mechanism. The solvent is adsorbed on the catalyst surface using molecular orbitals having unshared pairs of electrons or, in the case of the boranes, at atoms deficient in electron density. The relative effects for the donation of different electron densities to the metal crystallite were followed through product distributions from the deuteriumation or isomerization of styrene, 1-hexene, or d-limonene in various solvents. Product distribution data show that when a higher electron density is donated to a precious metal crystallite, more double bond isomerization or isotope exchange occurs in the reactants. The higher electron density also results in a slower rate of reduction. In the reaction mechanism it is proposed that the higher electron density of the metal crystallite stabilizes the metal-to-carbon bond of the half-hydrogenated state. This higher stability allows for more double bond isomerization or isotope exchange at adjacent carbon atoms. Combinations of solvent, substrate and catalyst were all found to verify this proposed mechanism. (Diss. Abstr. Int., B)

Feed Materials Processing

Refer also to abstract 16018.

Radiation Chemistry

Refer also to abstracts 15005, 15069, 15074, 15628, 15776, 15810, 16456, and 16472.

14928 (AREAEE-182) RADIATION-CHEMICAL REACTIONS IN AQUEOUS SOLUTIONS. Alian, A.; Haggag, A. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 28p. Dep. NTIS (US Sales Only) $4.50.

The theoretical aspects of the effect of radiation on water, acids,

and aqueous solutions of multivalent ions are discussed. Water being the most important solvent, it is the major component in most aqueous solutions, that absorbs nearly all the energy of any radiation incident to it, interactions are subsequently transferred to the solutes in varying degrees. Among acids, HCl and HNO_3 are the most unstable, little decomposition of H_2SO_4 and $HClO_4$ takes place while H_3PO_4 is exceptionally stable towards the effect of radiations. Radiation-chemical effects on solutions of multivalent ions have been clarified through the radiolytic oxidation of Fe^{2+} and Ce^{3+}, radiolytic reduction of Au^{3+} and Ce^{4+} and effects on various oxidation states of plutonium. A systematic study was carried out on the radiolytic oxidation of Sb^{3+} to Sb^{5+} in H_2SO_4 and HCl, under the effect of ^{60}Co gamma-radiation. The G-value was measured as a function of time of irradiation and antimony concentration. The G-value was found to decrease with the decrease of antimony concentration. The effect of non-polar liquids on the radiolytic oxidation of Sb^{3+} was also investigated; some of these liquids have an appreciable sensitizing effect (in HCl solutions), while others have a protective effect. The latter liquids can thus be used for keeping radioantimony(III) of high specific activity in the trivalent state. (auth)

14929 (CEA-CONF-2603) RADIOLYSIS PRODUCTS OF LOW MOLECULAR WEIGHT FORMED DURING THE GAMMA IRRADIATION OF CORNSTARCH: STATUS OF THE WORK. Berger, G.; Dauphin, J. F.; Athanassiadis, H.; Saint-Lebe, L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). 1973. 16p. (In French). (CONF-731079-1). Dep. NTIS (US Sales Only) $4.00.

From symposium on the identification of irradiated foods; Karlsruhe, F.R. Germany (24 Oct 1973).

The aim of the research work conducted in the Foodstuffs Preservation Laboratory on the products of starch radiolysis is to expand and clarify the toxicological evaluation studies which have also been carried out on microorganisms and higher animals. To date, aldehydes (formaldehyde, acetaldehyde, malonaldehyde), a cetone (acetone), alcohols (ethanol, methanol), sugars (maltose, glucose, mannose, fructose, galactose, ribose, arabinose, xylose, erythrose), an acid (formic acid), esters (probably lactons), and a peroxide (hydrogen peroxide) have been identified by one or several methods (colorimetric analysis, thin layer, liquid and gas chromatography, mass spectrometry, use of enzymes). Concentrations of most of them were measured as a function of the irradiation parameters (dose, up to 2 Mrad, dose rate, atmosphere, temperature), the characteristics of the starch (hydration, impurities), storage conditions (temperature, light of time), and the effects of a heat treatment were compared with those of irradiation. A specific test for irradiation of starch, based on colorimetric analysis of malonic aldehyde, showed a dose of 25 krad, even after 3 months storage at normal temperature. A temporary degradation process of starch under irradiation and some mechanisms of formation are proposed. (auth)

14930 (COM-74-10899) INDEX AND CUMULATIVE LIST OF PAPERS ON RADIATION CHEMISTRY. Volume VI, Numbers 27-52, July Through December 1973. (National Bureau of Standards, Washington, D. C. (USA)). Jan 1974. 354p.

The references are assigned identifying numbers. For each paper the first two digits refer to the year of publication, the third digit defines the category, and the last three digits are serial numbers within that category. The categories are: radiation chemistry, pulse radiolysis, polymers, molecular radiobiology, hot atom chemistry, ESR, luminescence, photochemistry, theoretical, and miscellaneous. Author and keyword indexes are included. (MCG)

14931 (EPA-R-2-73-260) GAMMA-INDUCED LOW-TEMPERATURE OXIDATION OF TEXTILE EFFLUENTS. Case, F. N. (Oak Ridge National Lab., Tenn. (USA)). May 1973. 59p.

Gamma irradiation of textile mill effluents under O_2 pressures $\leq$ 1,500 psi, with and without activated charcoal, was studied as a method for removing color and substances contributing to the COD. Both color and COD reduction are directly related to the radiation dose and pressure of the O_2 over the dye solution samples during irradiation. Color removal was achieved in solutions of dye prepared in the laboratory for process evaluation and for authentic textile mill waste effluents. A new method was revealed for in situ reactivation of charcoal by gamma-radiation-induced oxidation of organic compounds adsorbed on charcoal. This discovery permits a large reduction in the gamma source size required for processing textile mill effluents because the water fraction of the effluent does not need to be irradiated to the same degree as the organic material contained in the effluent. (Pollut. Abstr.)

14932 (EUR-5122(Vol.2), pp 669-676) ESR-INVESTIGATIONS OF RADIATION-INDUCED RADICALS AT 4° ABSOLUTE TEMPERATURE. Grillmaier, R.; Feil, H. (Univ. des Saarlandes, Ger.). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Samples of water, 10% glycerol in water, and tissue culture medium were cooled to 4°K and irradiated with 4000 rad x rays. Immediately the first measurement in the ESR spectrometer also at 4°K was performed. The samples were annealed stepwise at 20, 40, 60, and so on up to 200°K and the ESR spectra studied. Concentrations of hydrogen radicals were practically equal in all three samples. Radical concentrations continuously decreased with increasing temperature. (MCG)

14933 (LIB/Trans-525) EXPERIMENTAL IRRADIATION PLANT FOR MAKING SEWAGE SLUDGE HYGIENIC. Motsch, H.; Sub, A. Translated from Abwassertechnik; No. 6, 2-4(1973). 11p. Dep. NTIS (US Sales Only) $4.00.

A description is given of an industrial plant, which uses ionizing radiation to purify sewage. Gamma radiation from cobalt 60 rods is used to kill bacteria and parasites in the sewage sludge. Safety, cost, and expected advantages from irradiation are discussed. (RL)

14934 (NP-20058) RADICAL PAIR FORMATION IN n-DECANE AND n-DECANE-d_{22} SINGLE CRYSTALS BY γ IRRADIATION. Evidence by Electron Spin Resonance for Pairwise Trapping at Six Different Distances. Gillbro, T.; Lund, A. (Forskningsraadens Lab., Studsvik (Sweden)). 1974. 22p. (LF-50). Dep. NTIS (US Sales Only) $4.00.

Radicals and radical pairs in γ-irradiated single crystals of n-decane, n-decane-d_{22} and n-octane-d_{22} have been studied by means of electron spin resonance. A simple device was constructed to permit orientation of single crystals in the magnetic field at sub-ambient temperature. In n-decane two different radical species, $CH_3\dot{C}H(CH_2)_7CH$, R(I), and $-CH_2\dot{C}HCH_2-$, R(II) are produced. The hyperfine coupling tensor for the α-proton of the R(I) radical has the principal elements A_{xx} = 11.7 G, A_{yy} = 35.2 G and A_{zz} = 19.6 G. In n-decane-d_{22} only one species of radical, $-CD_2\dot{C}DCD_2-$, R_D(II), is formed. The radical pairs in n-decane and n-decane-d_{22} consist to two R(II) or R_D(II) radicals. In n-decane-d_{22} six different radical pairs, differing in their fine-structure splitting, are observed and of the total amount of radicals about 3% are paired at 77°K. Each radical pair is characterized by a certain temperature above which it is unstable. A short distance between the radicals constituting the pair implies a low degree of thermal stability. The radical pairs are believed to disappear by recombining to form dimers. The mechanism of radical pair formation is discussed. (auth)

14935 (NP-20060) ESR AND STRUCTURE OF SULFUR-CENTERED RADICALS AND RADICAL IONS. γ-Irradiated Dimethyl Disulfide and Methane Thiol Single Crystals at 77°K. Gillbro, T. (Forskningsraadens Lab., Studsvik (Sweden)). 1974. 24p. (LF-51). Dep. NTIS (US Sales Only) $4.25.

Single crystals of dimethyl disulfide and methane thiol were irradiated at 77°K. CH_3S radicals were produced in both compounds and measurement of the isotropic coupling constant from the methyl protons gave a value of 7.6 G. In the dimethyl disulfide crystal both the anion $CH_3SSCH_2^-$, and the cation $CH_3SSCH_3^+$, radicals were observed. The disulfide anion radical exhibited an isotropic septet of lines with a = 5.0 G. Comparison with measurements on a polycrystalline sample gave $g_\perp$ = 2.020 and $g_\parallel$ = 2.002 for this radical. The disulfide cation radical exhibited an evenly spaced septet of lines with a = 9.1 G and a maximum value for the g factor of 2.032. On illumination with ir radiation (λ > 590 mm) the disulfide cation radicals were easily bleached together with 50% of the disulfide anion radicals suggesting a photoinduced neutralization process. The presence of weak ^{33}S satellite lines in the anion radical spectrum indicates that 12% of the unpaired spin is localized to the two sulfur 3s orbitals. The structure of the disulfide cation radical is discussed in relation to earlier studies and a dihedral angle of 180° is proposed. The mechanisms for radical formation and decay in dimethyl disulfide and methane thiol are also discussed. (auth)

14936 (NSRDS-NBS-48) RADIATION CHEMISTRY OF ETHANOL: A REVIEW OF DATA ON YIELDS, REACTION RATE PARAMETERS, AND SPECTRAL PROPERTIES OF TRANSIENTS. Freeman, G. R. (Notre Dame Univ., Ind. (USA). Radiation Lab.). Feb 1974. 43p. GPO $0.80.

The yields (G) for products and intermediates formed by irradiation of ethanol, in the solid, liquid and gaseous state, were compiled and reviewed. Rates of reactions of transient ions and radicals and spectroscopic parameters, including optical and esr spectra, are also included. (auth)

14937 (ORO-3106-51) RADIATION CHEMISTRY OF HYDROCARBON AND ALKYL HALIDE SYSTEMS. Progress Report.

Hanrahan, R. J. (Florida Univ., Gainesville (USA)). 1974. Contract AT(40-1)-3106. 24p. Dep. NTIS $4.25.

Progress is reported in the following areas: gas-phase radiolysis of C_2F_6–C_2H_6 mixtures; gas-phase radiolysis and photolysis of ethyl bromide; radiolysis and mass spectrometry of CF_3I and C_2F_5I; radiation chemistry and hot atom chemistry of tetrafluorocyclobutane; and rare gas sensitized reactions of hexafluoroacetone. (LK)

14938 EPR OF γ-IRRADIATED CRYSTALS OF DL-THREONINE AT ROOM TEMPERATURE. Close, D. M.; Anderson, R. S. (Clark Univ., Worcester, MA). J. Chem. Phys.; 60: No. 7, 2828-2831(1 Apr 1974).

The room temperature EPR spectra of γ-irradiated crystals of DL-threonine, $CH_3CH(OH)CH(N^+H_3)CO_2^-$, and of deuterated DL-threonine, $CH_3CH(OD)CH(N^+D_3)CO_2^-$, were studied. Both crystals show complex spectra resulting from the overlap of signals from two different paramagnetic species. In the deuterated crystal, the EPR spectrum was simplified by uv photobleaching to remove one paramagnetic species. The remaining, stable radical was identified as $CH_3\dot{C}(OD)CH(N^+D_3)CO_2^-$, resulting from an H abstraction. Similarly, the stable radical remaining in the uv photobleached normal crystal was identified as $CH_3\dot{C}(OH)CH(N^+H_3)CO_2^-$. The observed hyperfine couplings are $A_\beta^H = 32.8$ G, $A_{methyl}^H = 19.1$ G, $A_\beta^N = 4.4$ G, and $A_{OH}^H \sim 3$ G. Precise determination of g values was not possible. Using the known crystal structure of DL-threonine and the measured hyperfine coupling constants, the orientation of the damaged molecule in the host crystal was calculated. (auth)

14939 ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED CADMIUM FORMATE DIHYDRATE AND MANGANESE(II) IONS IN CADMIUM FORMATE DIHYDRATE. Booth, R. J.; Herring, F. G. (Univ. of British Columbia, Vancouver). J. Chem. Phys.; 60: No. 7, 2773-2778(1 Apr 1974).

ESR spectra of radiation-induced Cd^+ ions were observed in monoclinic $Cd(HCO_2) \cdot 2H_2O$ at 77°K. A single-crystal study showed that there is a preferred capture by Cd^{2+} ions occupying the more asymmetric of the two cation sites. A comparative study of Mn^{2+} ions, substitutionally introduced into $Cd(HCO_2)_2 \cdot 2H_2O$, carried out at room temperature confirmed this result. The Mn^{2+} ions showed no preference for either of the sites. The results indicate that there is little distortion of the crystal structure on cooling or when the electron excess center is produced. (auth)

14940 ESR SPECTRA OF BrO_3 AND BrO_3^{4-}. Byberg, J. R.; Kirkegaard, B. S. (Aarhus Univ., Denmark). J. Chem. Phys.; 60: No. 7, 2594-2597(1 Apr 1974).

ESR spectra of x-irradiated single crystals of $KBrO_3$ show that the paramagnetic species previously identified as BrO_3 has a large, nonaxial quadrupole interaction and nonparallel principal axes for the g, A, and Q tensors. These findings suggest that the ESR signal should be assigned to a BrO_3^{4-} ion having C_s symmetry rather than to BrO_3. ESR spectra of x-irradiated crystals of KNO_3 doped with bromate ions exhibit a signal from a bromine-containing species having a cylindrical spin Hamiltonian analogous to that of ClO_3. This signal was assigned to the species BrO_3. Both assignments are supported by a modified extended Hückel calculation of field gradients and spin densities at the bromine nuclei of BrO_3 and BrO_3^{4-}. (auth)

14941 STRUCTURE OF RADICALS PRODUCED BY γ RADIOLYSIS. Part III. Radicals Derived From Adamantane, Adamantyl Derivatives, and Diamantane. Hyfantis, G. J.; Ling, A. C. (West Virginia Univ., Morgantown). Can. J. Chem.; 52: No. 7, 1206-1215(1 Apr 1974).

The effects of γ-radiolysis on adamantane, perdeuterated adamantane, diamantane, 1- and 2-chloroadamantane, 1- and 2-bromoadamantane, 1-cyanoadamantane, 1- and 2-adamantanol, 1- and 2-adamantylamine were examined via electron spin resonance techniques, and the nature of the predominant species produced is discussed. Spin scavenging experiments using 2-methyl-2-nitrosopropane were used, together with previously reported Br_2 scavenging experiments, to identify the nature of the predominant species produced when purified solid adamantane is subjected to radiolysis. Data indicate that this is the 1-adamantyl radical. A possible reason for the controversial nature of data on this subject reported previously by other investigators is given. (auth)

14942 RUBBER AND RADIATION. Present Status of the Study on Radiation Bridging of Rubber. Takahashi, Y. (First Atomic Power Industry Group, Tokyo). FAPIG (Tokyo); No. 67, 180-188(Nov 1972). (In Japanese).

Possible application of radiation chemistry to the rubber industry is for bridging of rubber by irradiation; polymerization, graft polymerization, and modification of rubber by irradiation; and development of radiation-resistant rubber. Of these applications, review was made on the radiation bridging of rubber, especially on the relation between mode of the bridging and properties of rubber, promoting role and effect of halogen compounds on solid rubber, liquid rubber, and latex rubber, the relation between role of promoting and bridging agents of polyfunctional monomers, and nature of the resulting rubber, and bridging of liquid rubber. Characteristic of the irradiation bridging appears in various aspects. One example is that the bridging is much accelerated by the addition of bridging agents. The typical bridging agents are some halogen compounds such as chloroform, hexachloroethane, and monochlorostyrene. Addition of the polyfunctional monomers, such as polyvinyl chloride and m-phenylenedimaleimide, is very effective for the bridging of polyethylene, polyvinyl chloride, and polyvinyl acetate. The irradiation bridging of the liquid rubber is now attracting interest of many investigators. For example, various different characteristics are obtained by the irradiation of unsaturated oligoester urethane and oligoester styrene because of different bridging effects. (JA)

14943 NEW INFORMATION ON KINETICS IN PULSE RADIOLYSIS FROM MEASUREMENTS OF CHERENKOV LIGHT AUTOABSORPTION. Zagorski, Z. P.; Zimek, Z. (Instytut Badan Jadrowych, Warsaw). Nukleonika; 19: No. 4, 275-281(1974). (In Polish).

Information about kinetics is described, which may be gained from specific pulse radiolysis studies consisting in measurement of intermediate concentrations during a micro-second pulse of 10-13 MeV electrons at a dose of up to 90 krads per pulse. Unlike conventional pulse radiolysis, which deals with decays governed most often by first or second order kinetics in the radiolytic process of formation, zero-order or steady-state kinetics dominates. The first type was illustrated by the linear formation of O_3^- in the system 1 M NaOH, 10^{-3} M O_2, the second one by the formation of e_{aq}^- in the alkaline, oxygen-free solution. (auth)

14944 NON-GASEOUS RADIOLYSIS PRODUCTS OF 6-AMINOPENICILLANIC ACID AND POTASSIUM SALT OF BENZYLPENICILLIN. Dziegielewski, J. (Univ., Warsaw); Jezowska-Trzebiatowska, B.; Siemion, I. Z.; Zabza, A. Nukleonika; 19: No. 4, 291-301(1974).

The radiolysis products of 6-aminopenicillanic acid (6-APA) and potassium salt of benzylpenicillin G, irradiated with γ-rays were separated by the extraction methods and chromatographically by the thin-layer method. On the basis of the ir and uv spectroscopic investigations as well as by the NMR and mass spectrometry methods of the radiolysis products, the paths of the radiation decomposition of 6-APA and of penicillin G were determined. In the radiolysis products of 6-APA the fractions of molecular weight higher than that of the irradiated substance were isolated. That was explained by dimerization based on acylation of radicalized amine group of one molecule by the β-lactam ring of another molecule. The 6-APA radiolysis products arise also as the result of cleavage of β-lactam and thiazolidine rings. The radiolysis products of penicillin G show the molecular weight different from that of the irradiated antibiotic. They are formed as the result of cleavage of bondings in the β-lactam thiazolidine ring, as the result of decarboxylation or separation of aromatic ring and methyl groups. A qualitative determination of the radiolysis products of 6-aminopenicillanic acid (6-APA) and potassium salt of benzylpenicillin (penicillin G) was attempted in order to locate by this method the bond cleavage sites in the molecules of antibiotics under investigation. (auth)

14945 NON-GASEOUS RADIOLYSIS PRODUCTS OF PROCAINE BENZYLPENICILLIN AND Na SALT 2-ORTHO-CHLORO-5-METHYL-4-ISOXASOLYL PENICILLIN. Dziegielewski, J.; Jezowska-Trzebiatowska, B. (Univ., Wroclaw). Nukleonika; 19: No. 4, 303-313(1974).

Radiolysis products of procaine benzylpenicillin and Na salt 3-ortho-chlorophenyl-5-methyl-4-isoxasolyl penicillin were isolated and spectroscopic studies were made over the NMR, ir, uv, and mass spectrometric ranges. On the basis of the results obtained, the bond breakage sites resulting from irradiation were determined and the modes of radiolysis decomposition were suggested. Irradiation of penicillins has been found to result in decomposition of the β-lactam and thiazolidine rings. Besides, decarboxylation of penicillins and bond cleavages within the amide group were observed as well as dehydrogenation and abstraction of simple hydrocarbons. The role of procaine and crystallization water in the radiolysis of penicillins was determined. (auth)

14946 RADIATION STABILITY INCREASE OF POLY(VINYL CHLORIDE). I. Radiation Yield of Hydrogen Chloride in Pure Poly(Vinyl Chlorides) Irradiated by γ ^{60}Co. Szymanski, W.;

Lerke, I.; Smietanska, G. (Univ., Torun, Poland). Nukleonika; 19: No. 4, 323-328(1974). (In Polish).

The G_{HCl} values for several poly(vinyl chloride) powders manufactured in Poland were determined. The G_{HCl} value does not depend on the dose in the range 0.2–7.5 Mrad and on the dose rate in the range 10^2–10^5 rad/min. For all polychlorides investigated the average G_{HCl} is about 20. (auth)

14947 RADICAL FORMATION DURING SOLID-PHASE IRRADIATION. pp 79-113 of EPR Svobodnykh Radikalov v Radiatsionnoi Khimii. Pshezhetskii, S. Ya. (ed.). Moscow; Khimiya (1972). (In Russian).

Consideration is given to the details of radiation reactions in the solid phase, which lead to the formation of radicals and other paramagnetic particles. General regularities are looked at in the formation of free radicals under the action of ionizing radiation in a condensed phase and conversions of these radicals: recombination, interaction of radicals with molecules, and the conversion of radicals under the action of light. The EPR method makes it possible to study not only radicals and atoms, but also charged paramagnetic particles occurring on irradiation, in particular, stabilized electrons. Thus it was possible to investigate more completely the mechanism of radiation reactions in the condensed phase, that is, the mechanism of kinetically delayed processes of radiation chemistry. (SJR)

14948 EPR SPECTRA AND FORMATION OF RADICALS IN IRRADIATED HYDROCARBONS. pp 147-195 of EPR Svobodnykh Radikalov v Radiatsionnoi Khimii. Pshezhetskii, S. Ya. (ed.). Moscow; Khimiya (1972). (In Russian).

Experimental data are presented on radicals formed during irradiation of saturated, unsaturated, and aromatic hydrocarbons. The radicals were studied by EPR spectroscopy. In explaining the mechanism of radical formation under irradiation, data from EPR, mass-spectroscopy, radiolysis, and photolysis were compared. (SJR)

14949 EPR SPECTRA AND RADICAL FORMATION IN IRRADIATED, MONOFUNCTIONAL ORGANIC COMPOUNDS AND IN BINARY MIXTURES. pp 196-281 of EPR Svobodnykh Radikalov v Radiatsionnoi Khimii. Pshezhetskii, S. Ya. (ed.). Moscow; Khimiya (1972). (In Russian).

Consideration is given to the formation of free radicals in irradiated organic compounds: in alkyl halides, aliphatic alcohols, aliphatic amines, carbonic acids, sulfur-containing compounds, and in binary mixtures of organic compounds. Radicals were investigated by EPR spectroscopy. From the EPR spectra, definite conclusions were drawn on the mechanism of radical formation. (SJR)

14950 RADICALS IN IRRADIATED ETHYL IODIDE AND RELATED COMPOUNDS. Lyons, A. R.; Symons, M. C. R.; Mishra, S. P. (Univ. of Leicester, Eng.). Nature (London); 249: No. 5455, 341(24 May 1974).

In studies of the radiolysis of alkyl halides it has been found that a multi-line ESR spectrum is obtained from ethyl iodide at 77°K. So far there has been no satisfactory interpretation of such a complex spectrum. It is thought that the radical CH_3CH_2---I^- is a likely candidate for these effects, and it is suggested that the process involved in $RI + e^- \rightarrow R$---I^-, in which the radical R· has its normal planar geometry, but under favorable circumstances exhibits a very weak charge transfer interaction with iodine. It is also suggested that the occurrence of this interaction, and its magnitude, is governed primarily by the crystal structure of the host compounds and by the mobility of the alkyl radical. Results for CD_3OD solution show that the interaction is lost when iodide can be solvated. (UK)

14951 LYOLUMINESCENCE OF TREHALOSE DIHYDRATE. Atari, M. A.; Ettinger, K. V. (Univ. of Birmingham, Eng.). Nature (London); 249: No. 5455, 341-342(24 May 1974).

It is stated that lyoluminescence of trehalose·$2H_2O$ in water has been observed over a wide range of radiation doses. Free radicals formed during irradiation of the solid probably cause the light emission when they are liberated to react in solution. Experimental evidence is presented for the type of diffusion controlled reactions involved in the process of light emission. Amongst other things when irradiated saccharides are annealed they tend to exhibit more lyoluminescence, as a result of the temperature-assisted diffusion of O_2 during annealing. When luminol solution was used instead of water, a twenty-fold enhancement of light emission was observed. A linear relationship was obtained between radiation dose (^{60}Co γ) and integrated light intensity between 100 mrad and 150 krad. A sample heated to 80°C for 2 hr showed no change in light output and heating to 60°C for 60 hr caused a decrease of only 18%. (UK)

14952 SOME ASPECTS OF γ-RADIOLYSIS OF POLYISOPRENE IN THE FORM OF NATURAL RUBBER LATEX. Ambroz, H. (Inst. of Nuclear Research, Warsaw). J. Polym. Sci., Part C; No. 42, 1339-1345(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

The most important radiation-induced reactions of polyisoprene in the form of natural rubber latex are cross-linking and dislinking. They have been tested in the system with six methane halides at 77, 195, 273, and 328°K. Chlorides are sensitizers of the cross-linking process within the whole range of temperatures studied. Bromine and iodine derivatives exhibit different features depending on temperature and composition. The activation energies of the cross-linking process in sensitized and unsensitized systems have been evaluated within the range of high and low temperatures. The dislinking of polyisoprene estimated on the basis of the Charlesby-Pinner theory varies from 0.3 to 5% of cross-links, depending on experimental conditions. The role of oxygen in polyisoprene radiolysis and aging resistance of cross-linked latex films has been also examined. (auth)

14953 EFFECT OF ^{60}Co GAMMA RADIATION ON ALKALI METAL PERIODATES IN AQUEOUS SOLUTIONS. Hassan, N.; Heitz, C. (CNRS, Strasbourg). J. Chim. Phys.; 71: No. 2, 127-129(Feb 1974). (In French).

The radiolytic reduction of alkali metal periodates in aerated and deaerated aqueous solutions was investigated. Dose rate and pH effects were examined. A direct and indirect radiation effect was observed. G indirect ($-IO_4^-$) is 4.5 at pH 1.25 and 7.3 at pH 7. (FR)

14954 STUDY OF RADICALS FORMED BY THE IRRADIATION OF PYRIDINE ADSORBED ON THE ZEOLITE, $Na_{56-x}H_xY$ USING ELECTRON PARAMAGNETIC RESONANCE. Abou Kais, A. J. Chim. Phys.; 71: No. 1, 111-112(Jan 1974). (In French).

The existence of two types of pyridine adsorbed on the zeolite, $Na_{56-x}H_x$, was confirmed from the two signals obtained, one at calcination temperatures of less than 200°C (corresponding to the radical $C_5H_5NH^+$) and the other at calcination temperatures of more than 200°C (corresponding to the radical $C_5H_6NH^+$). These signals correspond to physically adsorbed pyridine, and to pyridinium ions formed by the action of pyridine on OH groups associated with the 3650 cm^{-1} band in the IR, respectively. (FR)

14955 RADIOTHERMOLUMINESCENCE OF POLYETHYLENE WITH DIFFERENT CHAIN CONFORMATIONS. Nikol'skii, V. G.; Zlatkevich, L. Yu.; Konstantinopol'skaya, M. B.; Osintseva, L. A.; Sokol'skii, V. A. (Inst. of Chemical Physics, Moscow). Dokl. Phys. Chem.; 213: No. 1-3, 946-949(Nov 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 1, 134-137 (Nov 1973).

Relaxation processes in samples of polyethylene with a folded conformation of the chain and in samples with the straight conformation were investigated using the method of radiothermoluminescence. Luminescence curves of samples of polyethylene degassed and then irradiated at 77°K with gamma rays were obtained. The activation energy of relaxation E_{act} was determined by the method of initial rates using the stepwise heating of the samples to successively increasing temperatures. (LK)

14956 SOLID-PHASE MONOMER-TO-RADICAL ADDITION AT 77°K UNDER THE ACTION OF IONIZING RADIATION. Gordon, D. A.; Migunova, I. L.; Mikhailov, A. I. (Inst. of Chemical Physics, Moscow). Dokl. Phys. Chem.; 213: No. 1-3, 974-977 (Nov 1973).

Translated from Dokl. Akad. Nauk SSSR, 213: No. 2, 368-371 (Nov 1973).

A solid-phase addition of the monomer molecule to a free radical under the action of ionizing radiation at 77°K was observed by the ESR method. The following compounds were investigated: p-diethynylbenzene (p-DEB, mp 92°C); phenylacetylene (PA, mp −44°); maleimide (MI, mp 92°); phenylmaleimide (PMI, mp 89.5°); ethylmaleimide (EMI, mp 40°); and acenaphthylene (ACN, mp 92°). These are very bulky molecules with large intermolecular interactions in their crystals and with comparatively high melting points. Irradiation of the samples was performed in a ^{60}Co γ-source, a U-12 electron accelerator, and UV light from a DRSh-1000 lamp. (LK)

14957 EFFECT OF PRESSURE IN THE GAMMA RADIOLYSIS OF CYCLOHEXANE IN THE VAPOR PHASE. Milon, H.; Gaeumann, T. (Eidgenoessische Technische Hochschule, Lausanne, Switzerland). Helv. Chim. Acta; 57: No. 3, 721-729(Apr 1974).

The vapor phase γ radiolysis of cyclohexane was investigated as a function of pressure, from 100 to 0.5 Torr, in vessels of different dimensions. With decreasing pressure, the yield of

hydrogen and substituted cyclohexanes is decreased and the formation of molecules having less than six carbon atoms is enhanced. The curves of yield vs. pressure have a sigmoid shape from which a transition pressure is defined depending only on the dimensions of the vessels, the variation of the yield of a given product being the same for all the vessels. A simple model of competition between the neutralization of the ions in the volume and their diffusion to the surface where they are neutralized is proposed and discussed. From the slope of the curve of the inverse of the transition pressure vs. the square of the characteristic diffusion length, a maximum life-time of 68 ms was evaluated for the ions, using a calculated value of the cyclohexane ions diffusion coefficient. (auth)

14958 CREATION OF BIVALENT HOLMIUM BY IRRADIATION. Apers, D. J.; De Block, R.; Capron, P. C. (Louvain Univ., Heverlee, Belgium). J. Inorg. Nucl. Chem.; 36: No. 7, 1441-1445(Jul 1974).

Electrophoretic studies, corroborated by polarography, chronopotentiometry and titrations have shown the existence of a bivalent oxidation state of holmium. Yields up to 5.4% Ho(II) can be attained when samples of holmium oxide are submitted to gamma doses of 10 Mrad. (auth)

14959 EFFECT OF RADIATION ON THE EXTRACTION OF Pu(IV) BY TRILAURYLAMINE. Bhattacharyya, P. K.; Veeraraghavan, R. (Bhabha Atomic Research Centre, Trombay, India). Radiochem. Radioanal. Lett.; 17: No. 5-6, 297-303(30 Jun 1974).

The distribution coefficient (Kd) values of Pu(IV) in TLA-xylene-HNO_3 system at different acidities under the influence of γ radiation were found to be less than those obtained in the absence of the radiation. The decrease of Kd values in presence of radiation was attributed to the formation of Pu compounds with unknown radiolytic products. (auth)

14960 INVESTIGATION OF THERMAL AND THERMOOXIDIZING DEGRADATION OF IRRADIATED POLYETHYLENE. Leshtchenko, S. S.; Pavlova, Zh. D.; Egorova, Z. S.; Karpov, V. L. (Inst. of Physical Chemistry, Moscow). J. Polym. Sci., Part C; No. 42, 1261-1270(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

The peculiarities of thermal and thermooxidizing degradation of low- and high-density polyethylene (PELD, PEHD) and the ethylene-propylene copolymer (CEP-7) irradiated over the range of 1 to 300 Mrad were studied. It was established that the change of structure of polymer by irradiation resulted in an increase of thermostability and a decrease of thermooxidation stability. The change of content of double bonds as a result of pyrolysis was studied. It was suggested that trans-vinylene double bonds promoted the development of thermal degradation of irradiated polymer and vinylidene double bonds were slowing down this process. It was found that in nonirradiated branched PELD and CEP-7 side groups and tertiary carbon atoms oxidized. In nonirradiated linear PEHD the oxidation occurred mainly with the participation of secondary carbon atoms. The initial polymer structure had an influence on the process of oxidation of irradiated polymers. Cross-linking bonds and tertiary carbon atoms were the most vulnerable to the oxidation of irradiated polymers. Simultaneously with the degradation, during oxidation of irradiated polymers a structuralization with the formation of ether bonds R-O-R takes place. (auth)

14961 STRESSED POLYMER AGEING UNDER IRRADIATION AND IN CHEMICALLY ACTIVE MEDIA. Regel, V. R.; Vershinina, M. P. (Ioffe Inst. of Physics and Tech., Leningrad). J. Polym. Sci., Part C; No. 42, 1405-1409(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

The results of the experimental study of the lifetime of stressed polymers under the action of irradiation of various kinds and in chemically active media are summarized. The lifetime of polymers under the action of additional destructive factors is compared with the lifetime of the same polymers in the absence of these factors. The results of the experiments are interpreted within the framework of the kinetic concept of strength. (auth)

14962 RADIATION DEGRADATION OF POLYMETHYLMETHACRYLATE IN THE PRESENCE OF LIQUID ORGANIC ADDITIVES. Dziedziela, W. M.; Sudzik, R.; Kroh, J. (Technical Univ. of Lodz, Poland). J. Polym. Sci., Part C; No. 42, 1419-1423(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

The effect of α-methylstyrene, ethylbenzene, and 2-mercaptoethanol on radiation-induced degradation of polymethylmethacrylate (PMM) was investigated. The deaerated viscous mixtures containing from 11 to 33 w/w % of PMM were irradiated with ^{60}Co gamma rays and molecular weight of polymers were determined by osmometry. The degradation of PMM in the presence of additives proceeded with higher yield as compared with pure solid polymer. The yields of main chain scission G(s) were found dependent on the nature and concentration of additives. Sensibilization effect increased in the order: α-methylstyrene, 2-mercaptoethanol, and ethylbenzene as the most effective agent. Within the concentration range investigated G(s) increased linear with concentration of additives. The mechanism of processes occurring during irradiation of PMM in the presence of additives is discussed. (auth)

14963 EFFECT OF IONIZING RADIATION ON DEXTRAN OF POLISH PRODUCTION. Orszagh, A.; Zawada, E.; Zurakowska-Orszagh, J. (Univ. of Warsaw). J. Polym. Sci., Part C; No. 42, 1467-1473(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

The main purpose of the present investigation is the study of the effect of γ-radiation on dextran of Polish production of various average molecular weights from several thousand to one hundred thousand, using various doses and conditions of irradiation. (auth)

14964 RADIATION-INDUCED POLYMERIZATION FEATURES OF AMINOALKYL MONOMERS. Usmanov, Kh.; Musaev, U. N.; Mirkhidoyatv, M.; Karimov, A.; Rakhimova, M. (Tashkent State Univ.). J. Polym. Sci., Part C; No. 42, 1601-1605(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

The rate of radical polymerization of vinyl monomers containing ionogenic groups or atoms with an unsplit pair of electrons depends generally on the nature of the environment. On polymerization of nitrogen-containing monomers it has been found that the nature of the environment has a considerable effect on the overall rate of reaction and on the value of rate constants of propagation reaction and chain rupture, respectively. This phenomenon is conditioned by intramolecular and intermolecular effects. Aminoalkyl ethers of acrylic acids obtained on the basis of aliphatic and heterocyclic amines refer to that class of monomers. To determine the role of the above-mentioned effects with gamma radiation-induced polymerization of aminoalkyl monomers, the polymerization of β-N,N-dimethylaminoethylmethacrylate (DMAEMA), β-N,N-diethylaminoethylmethacrylate (DEAEMA), bi-(dimethylamino)-isopropylmethacrylate (BDMAIPMA), and B-(-N-cytizene) ethylacrylate (CEA) was investigated. The comparison of polymerization rates of aminoalkyl monomers of equal conditions makes it possible to arrange them in the following sequence by increasing values of radiation-chemical yields: CEA < DMAEMA < DEAEMA < BDMAIPMA (values G are equal to 2.6×10^2, 1.2×10^4, 1.9×10^4, and 2.0×10^4 M/100 EV, respectively). (LK)

14965 RADICAL TRANSFORMATIONS IN PREIRRADIATED CELLULOSE AFFECTED BY DIFFERENT CONDITIONS. Usmanov, Kh. U.; Azizov, U. A.; Milinchuk, V. K.; Khamidov, D. S. (Research Inst. for Cotton Cellulose Chemistry and Tech., Tashkent). J. Polym. Sci., Part C; No. 42, 1607-1620(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

Results and experimental data on formation, decomposition, and different transformations of radicals in cellulose preparations at a wide temperature range and irradiation dose are summarized. Suppositions are presented on the mechanism of monomer polymerization in cellulose products which are thought to be of interest for studies in the field of radical processes (i.e., thermal, mechanical, photochemical, and irradiation-induced degradation) and, besides, in solving problems of synthesis of grafted and cross-linked cellulose derivatives. (auth)

14966 VINYL MONOMERS AND PREIRRADIATED CELLULOSE GRAFT COPOLYMERIZATION. Usmanov, Kh. U.; Azizov, U. A.; Sadykov, M. U.; Mirkamilov, I. M.; Yunusov, M. Yu.; Pulatov, E. D. (Research Inst. for Cotton Cellulose Chemistry and Tech., Tashkent). J. Polym. Sci., Part C; No. 42, 1639-1649 (1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

The results of investigations on acrylates (methacrylate, methyl methacrylate) and preirradiated cellulose preparation graft copolymerization are presented. Cellulose graft copolymers were obtained by two methods: (1) through interaction of monomers (solutions) and cellulose preirradiated in peroxide solutions, and (2) by interaction of preirradiated cellulose in vacuum with monomers from the vapor phase. (LK)

14967 IRRADIATION-INDUCED GRAFT COPOLYMERIZATION OF MONOMERS AND THEIR BINARY MIXTURES WITH CELLU-

LOSE. Usmanov, Kh. U.; Sadykov, M. U.; Azizov, U. A.; Mirkamilova, G. M.; Karimova, Sh. N. (Research Inst. for Cotton Cellulose Chemistry and Tech., Tashkent). J. Polym. Sci., Part C; No. 42, 1651-1661(1973).

From international symposium on macromolecules. Part 3; Helsinki, Finland (2 Jul 1972).

Acrylonitrile, methacrylate, vinyl acrylate, methyl methacrylate, and their binary mixtures were graft copolymerized with cellulose by gamma irradiation from a ^{60}Co source. The effect of factors such as irradiation dose, dose rate, peroxide content, concentration, and ratio on graft copolymer yield was studied. (LK)

14968 EFFECT OF ORIENTATION ON RADIATION BEHAVIOR OF POLYOLEFINS. Yurkevich, V. G.;. Karpov, V. L.; Zverev, B. I.; Aleksandrova, L. B. (Inst. of Physical Chemistry, Moscow). J. Polym. Sci., Part C; No. 42, 859-866(1973).

From international symposium on macromolecules. Part 2; Helsinki, Finland (2 Jul 1972).

This investigation was concerned with the effect of orientation on the radiation behavior of polymers, and was carried out on manufactured polyolefin fibers (polyethylene and polypropylene). The change of solubility, characteristic viscosity, and gelation mechanical properties by radiation were studied. The orientation parameter by the optical microscope, the isometrical heating, the radiothermoluminescence, and roentgen structure were analyzed, too. (auth)

14969 CHARACTERIZATION OF POLY(VINYL CHLORIDE) PREPARED BY RADIATION-INDUCED BULK POLYMERIZATION AT TEMPERATURES FROM-50° TO 90°C. Carenza, M.; Palma, G.; Tavan, M. (CNR, Padua). J. Polym. Sci., Part C; No. 42, 1031-1049(1973).

From international symposium on macromolecules. Part 2; Helsinki, Finland (2 Jul 1972).

Osmotic, viscometric, and light scattering measurements have been carried out on poly (vinyl chloride) samples, obtained by bulk polymerization on exposure to ^{60}Co γ-rays at dose rates varying over a 100-fold range and at regularly spaced temperatures from−50 to 90°C. While with the samples prepared at the higher temperatures, solutions could be conveniently made in tetrahydrofuran, cyclohexanone appeared to be a more suitable solvent when polymerization temperatures from 10°C downwards were concerned. Furthermore, with the latter cases, strong heating treatments of the solutions were required. Correlations among the various parameters, deduced from the measurements, were examined and found in agreement with reported relationships for conventional poly(vinyl chloride). The patterns of gradual change of molecular weight with changing polymerization conditions were discussed. (auth)

14970 MECHANISM OF RADIATION-INDUCED CROSSLINKING OF POLY(VINYL CHLORIDE) IN THE PRESENCE OF SOME POLYFUNCTIONAL MONOMERS. Sukhov, F. F.; Slovokhotova, N. A. (Inst. of Physical Chemistry, Moscow). J. Polym. Sci., Part C; No. 42, 147-153(1973).

From international symposium on macromolecules. Part 1; Helsinki, Finland (2 Jul 1972).

Some features of low-temperature radiolysis of poly(vinyl chloride) and the effect of added polyfunctional monomers such as triallyl cyanurate have been studied using the technique of infrared spectrophotometry. It has been found that the radiation yield of HCl formed in the radiolysis of poly(vinyl chloride) alone at 100°K is equal to 2.5. Additives form a complex with radiolytically produced HCl. The structure of this complex corresponds to an oxonium compound. The radiation yield of the complex reaches 50−80 per 100 eV of energy absorbed by additives. At the same time, the addition of triallyl cyanurate in poly(vinyl chloride) decreases the radiation yield of HCl associated with polymeric matrix by 2-3 times. The reaction of the allyl groups of the additive with the polymer free radicals already occurs at low temperatures. On heating the irradiated at low temperature samples, the complex of additive with HCl decomposes, the remaining allyl groups disappear, and triazine rings are partly transformed to the isocyanurate form. These results are interpreted in terms of a mechanism which postulates the localization of the dehydrochlorination process of poly(vinyl chloride) in the vicinity of the additive molecules and the promotion of crosslinking efficiency by the formation of complex of additive with HCl. (auth)

14971 RADIATION-INDUCED GRAFTING OF BUTADIENE TO CHLORINATED POLYETHYLENE AND POLY(VINYL CHLORIDE). Block, I.; Silverman, J. (Univ. of Maryland, College Park). J. Polym. Sci., Part C; No. 42, 191-200(1973).

From international symposium on macromolecules. Part 1; Helsinki, Finland (2 Jul 1972).

The radiation-induced grafting of butadiene (BD) from methanol solution to films of low-density polyethylene (LDPE), chlorinated polyethylene (PECL), and poly(vinyl chloride) (PVC) was studied as a function of chlorine content, dose rate, irradiation time, and BD concentration at room temperature. It was found that the graft yield to PECL increased with increasing glass transition temperature (T_g) of the polymer until the T_g of the chlorinated polymer was equal to the reaction temperature. As the degree of chlorination was increased beyond this point, little increase in graft yield was realized. Further increase in graft yield was obtained upon dilution of the monomer with methanol. The results are explained in terms of the effect of the added chlorine and absorbed monomer on the viscosity of the monomer-swollen amorphous polymer. (auth)

14972 CHEMICAL STRUCTURE OF RADIATION-CURED POLYESTER RESINS. Funke, W.; Schuh, H. (Univ., Stuttgart). J. Polym. Sci., Part C; No. 42, 379-385(1973).

From international symposium on macromolecules. Part 1; Helsinki, Finland (2 Jul 1972).

The structure of electron-beam-cured polyester resins has been compared with that of the same resins crosslinked by peroxide as a radical source. The copolymer chains of the radiation-cured system are shorter, their composition more uniform, and the chain length distribution much smaller than with the peroxide cured resins. Polyester resins crosslinked by electron beams therefore have a more homogeneous structure than peroxide-cured resins under usual conditions. (auth)

14973 GAMMA RADIOLYSIS OF OXALIC ACID AND SELECTED METAL OXALATES. Dougherty, P. L. Denver, CO; Univ. of Denver (1970). 121p. University Microfilms Order No. 74-11,462.

Thesis (Ph. D.).

Evacuated samples of oxalic acid and selected alkali and transition metal oxalates were irradiated at ambient temperatures with gamma radiation using a ^{60}Co source. Products of sample radiolysis were analyzed by various methods. Irradiated samples were dissolved in one normal perchloric acid to release gases trapped in the crystal lattice prior to gas chromatography analysis. The quantitative analysis of carbon dioxide was obtained via gas chromatography. The principal product of the radiolysis in all cases was carbon dioxide. Water was confirmed as a product of the radio-decomposition of oxalic acid and was a presumed product of oxalic acid dihydrate radiolysis. The moles of carbon dioxide produced was the basis for the mole percent decomposition curves and calculation of the G values for each sample. The mole percent decomposition curves of each compound indicated varying degrees of linearity over the dose range of one megarad to 200 megarads of absorbed dose. The following $G(CO_2)$ values were determined: oxalic acid, 7.4; oxalic acid dihydrate, 4.7; lithium oxalate, 1.55; sodium oxalate, 0.60; potassium oxalate monohydrate, 0.82; iron (II) oxalate dihydrate, 0.53; cobalt(II) oxalate, 0.46; nickel(II) oxalate dihydrate, 0.47; copper (II) oxalate hemihydrate, 1.93; zinc(II) oxalate dihydrate, 0.54; cadmium(II) oxalate trihydrate, 4.9; mercury(II) oxalate, 1.15; titanium(III) oxalate decahydrate, 4.1. Percent error varied from ± 1.5 to ± 6%. Water of hydration was assessed to have no effect upon carbon dioxide production. Decomposition mechanisms were proposed for oxalic acid, oxalic acid dihydrate, alkali metal oxalates and transition metal oxalates. The mechanisms were based upon this and previous investigations which used other analytical methods. The transition metal decomposition was related to various reduction steps in which the metal ion in the oxalate undergoes reduction as the determinate factor in the extent of radiolysis. Those transition metals not readily reduced via single electron transfer steps form oxalates more resistant to decomposition. Those transition metal ions with positive electrode potentials have significantly higher $G(CO_2)$ values than those with negative electrode potentials. The $G(CO_2)$ values of the alkali metal oxalates were linearly related to the metal densities, and related in order to the electrode potentials of the metals. (Diss. Abstr. Int., B)

14974 COBALT-60 GAMMA RADIOINDUCED HYDRODIMERIZATION OF AQUEOUS AND METHANOLIC METHYL VINYL KETONE. Coy, G. W. Boston; Boston Univ. Graduate School (1974). University Microfilms.

Thesis (Ph. D.).

An investigation was made into the cobalt-60 gamma radiation-induced reductive dimerization of methyl vinyl ketone solutions. Radiolysis of methanolic methyl vinyl ketone yielded polymer. G(-methyl vinyl ketone) was directly dependent on methyl vinyl ketone concentration and inversely dependent on dose rate. In previous work 2,7-octanedione was identified as the product. G(-methyl vinyl ketone), around 40, was independent of methyl vinyl ketone concentration and dose rate. The possibility is advanced that the irreproducibility may have been due to an impurity present in the earlier experiments. The radiolysis of methanolic methyl vinyl ketone in the presence of varying amounts

and combinations of hydroquinone, benzoquinone, and quinhydrone failed to reproduce previous results. Radiolytic hydrodimerization to 3-methyl-2, 6-heptanedione but not to 2,7-octanedione was achieved by the addition of ferricyanide and ferrocyanide cosolutes: 0.02 M methanolic methyl vinyl ketone irradiated in the presence of 1.5×10^{-4} M $K_3Fe(CN)_6$ and 1.5×10^{-4} M $K_4Fe(CN)_6$ yielded 14 ± 3% conversion to 3-methyl-2, 6-heptanedione (% conversion = 2 × G(3-methyl-2, 6-heptanedione)/G(-methyl vinyl ketone) × 100). No ethylene glycol was detected as a product. Other products were not identified. The following correlations were noted as the ratio (methyl vinyl ketone)/$(K_3Fe(CN)_6$ was increased: (1) G(-methyl vinyl ketone) increased, (2) per cent conversion of methyl vinyl ketone to 3-methyl-2,6-heptanedione decreased and (3) G(3-methyl-2,6-heptanedione) first increased then decreased. A twenty-fold variation in dose rate had no significant effect upon the results. Aqueous methyl vinyl ketone solutions were irradiated in the presence of the following cosolutes and failed to yield significant amounts of hydrodimerization products: KI, hydroquinone, HCO_2Na, 2-propanol and tertiary butanol. G(-methyl vinyl ketone) values in the presence of HCO_2Na, 2-propanol and tertiary butanol were not distinguishable from values in their absence. However, KI and hydroquinone reduced G(-methyl vinyl ketone) from values in the range 4.44 to 27.2 in the absence of cosolutes to around 0.9, which was independent of dose rate. (Diss. Abstr. Int., B)

14975 ENERGY TRANSFER IN RADIATION CHEMISTRY. I. Dynamics of the Electron-Oscillators System. Kutz, H. D.; Kozak, J. J. (Univ. of Notre Dame, IN). J. Math. Phys. (N. Y.); 15: No. 4, 508-519(Apr 1974).

Single-mode excitation events in radiation chemistry are investigated by considering a simple model: an electron (characterized by mass m and momentum ħk) in interaction with a collection of harmonic oscillators. The Hamiltonian corresponding to this model is identified, and then used within the framework of a master equation constructed from the time-dependent Schrödinger equation. The usual long-wavelength approximation is employed, which, in the infinite-system limit, necessitates an upper bound on the frequency spectrum of the oscillator bath. Once these constraints have been imposed, however, the time evolution of the system is determined exactly (i.e., no "weak-coupling" approximation) in two limiting regimes—the case of a low-energy incident electron and that of a high-energy incident electron. Results are compared with those obtained using a weak-coupling approximation, first within the framework of the master equation cited above and then in conjunction with the Prigogine–Résibois master equation, and it is pointed out that for the system under study, the use of a weak-coupling approximation in both equations leads to unphysical results. Results are also compared with those obtained earlier by Van Hove and co-workers on the electron–random scatterers model, and an attempt is made to understand the role of the approximations introduced in both models. (auth)

14976 INFLUENCE OF γ-RADIATION ON THE GLUTAMINIC ACID DECARBOXYLASE ACTIVITY IN STORED WHEATS. Bancher, E.; Stachelberger, H.; Washuettl, J. (Technische Hochschule, Vienna). Mikrochim. Acta; No. 3, 381-384(1974).

The winter wheat "Rekord" was irradiated with 50 and 500 krads and its glutaminic acid decarboxylase activity compared with that of a nonirradiated control; this actively was followed over a storage period of one year's duration. A manometric method was employed for the determination procedure. The results of the study showed a distinct rise of the GDC-activity in the samples irradiated with 50 and 500 krads as compared with nonirradiated controls. These activity differences persist over the entire storage period. The activity courses of all three experimental series exhibited a maximum in the fourth month of storage. (auth)

14977 PULSE RADIOLYTIC INVESTIGATION OF REACTIONS OF DIAMIDE WITH HYDRATED ELECTRONS AND OH RADICALS. Wold, E.; Brustad, T. (Norsk Hydros Institutt for Kreftforskning, Oslo). Int. J. Radiat. Biol.; 25: No. 4, 407-411(Apr 1974).

Second-order rate constants were determined for reactions of diazenedicarboxylic acid bis(N,N-dimethylamide) ("diamide") with hydrated electrons and OH radicals. Similar spectra are presented for pulse irradiated 5×10^{-5} M diamide solutions flushed with N_2 or N_2O. Nitrogen saturated solutions of $0-6 \times 10^{-5}$ M diamide irradiated with ~500 rads, yielded a 2nd order rate constant of $(2.9 \pm 0.2) \times 10^{10} M^{-1}s^{-1}$ for the reaction between diamide and the hydrated electron. N_2O-saturated solutions of $2 \times 10^{-5}-3 \times 10^{-4}$ M diamide, irradiated with 2 krads yielded a 2nd order rate constant of $7.7 \times 10^9 M^{-1}s^{-1}$ and competition kinetics studies carried out to exclude attack by H radicals showed a result of $(7 \pm 1) \times 10^9 M^{-1}s^{-1}$. (UK)

14978 RADIATION–CHEMICAL DECOMPOSITION OF LIQUID HEXANES AND HEXANE MIXTURES. I. γ-Radiolysis of Pure Hexanes. Foldiak, G.; Gyorgy, I. (Inst. of Isotopes, Budapest). Acta Chim. Acad. Sci. Hung.; 80: No. 4, 385-397(1974).

The radiation-chemical yields of hydrogen and of the dimeric hydrocarbons decrease and the G-values of the fragment hydrocarbons, C_1-C_5 increase with the number of methyl groups in the order: cyclohexane > n-hexane > 3-methylpentane > 2,3-dimethylbutane > 2,2-dimethylbutane. The yield of C_7-C_{12} hydrocarbon products formed via radical combination reactions is low compared to the total yield and is only slightly influenced by the structure of the carbon chain. It was found that: (1) of the investigated C_6-carbon chain structures the radiation stability of the ring structure is the highest, i.e., the fission of the C–C bond in the ring proceeds at the lowest rate; (2) of the C–C bonds in open-chain alkanes the terminal bond possesses the lowest fission probability and the probability of bond fission increases toward the middle of the chain; (3) the yield of the C–C bond fission increases with the order of the neighboring carbon atoms; (4) the yield of C–C bond fission decreases with increasing standard dissociation energy of the bond. It appears from the ratio G(C–H)/G(C–C) that there is a competition between the C–H and C–C bond fission reactions during radiolysis. (auth)

14979 HYDROSTANNYLATION INITIATED BY GAMMA RADIATION. Lopatina, V. S.; Sheverdina, N. I.; Chernoplekova, V. A.; Kocheshkov, K. A. (Inst. of Physical Chemistry, Moscow). Dokl. Chem.; 213: No. 4-6, 900-901(Dec 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 4, 846-847 (Dec 1973).

The results of γ-initiated hydrostannylation with triethyl- and tributylin hydride of a number of unsaturated compounds such as hydrocarbons, alcohols, ethers, esters, and amides are reported. The reaction products were characterized by elemental analysis and identified by boiling or melting point. The yield and the radiation-chemical yield in mol/100 ev were determined. (JSR)

14980 SECONDARY PRODUCTS FROM THE RADIOLYSIS OF TRICAPROIN. LeTellier, P. R.; Nawar, W. W. (Univ. of Amherst, MA). J. Agr. Food Chem.; 22: No. 4, 693-696(1974).

Tricaproin has been used as a model system to study the radiolysis of simple triglycerides. In addition to the primary radiolytic fragments and the recombination products reported earlier, certain compounds believed to result from more than one cleavage in the same parent molecule, or from the decomposition of some primary intermediates, were classified as "secondary radiolytic products." In the present report, the identification and mode of formation of these compounds are discussed. (auth)

14981 RADIATION DECAY OF COLLOIDAL CENTERS IN ADDITIVELY COLORED NaCl CRYSTALS. Chadaev, V. A. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 2, 45-48(1974). (In Russian).

The process of decay of large colloidal centers is stimulated in additively colored NaCl crystals by the electron microscopy technique. It is shown that starting with a crystal-absorbed dose of the order of 25 Mrad the "solarization" effect is observed—radiation decay of large colloidal particles of preradiation origin. The decay products of colloidal particles are F-, M-, X-centers and small colloidal particles. (auth)

14982 EFFECT OF GAMMA RADIATION ON ION-EXCHANGE RESINS. VII. Kinetics of the Sulfonic Groups Decomposition in the Cation Exchange Resin Imac C-12. Litowska, M.; Ostrowska, J. (Univ., Torun, Poland). Nukleonika; 19: No. 4, 283-290 (1974). (In Polish).

The kinetic analysis of the functional groups decomposition in the cation exchange resin Imac C-12 has been performed. The rate constants of the reaction of decomposition of sulfonic groups, as well as of the consecutive reaction of the sulfone cross-links damage, have been determined. On the basis of these constants and the calculated irradiation yield of the desulfonation and inactivation of groups the radiation stability of the Imac C-12 has been compared with the stability of the cation exchange resin KU-2. (auth)

14983 VERY-HIGH-DOSE-RATE RADIOLYSIS OF N-BUTANE IN THE GAS PHASE. Effect of the Addition of Electron Scavengers. Hatano, Y.; Takao, S.; Namba, H.; Ueno, T.; Shida, S. (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 47: No. 3, 741-742(Mar 1974).

The dose rate and its pulse-to-pulse reproducibility of very-high-intensity electron pulses were measured. The effect of the addition of electron scavengers on the neutralization processes in the gas-phase radiolysis of n-butane has been examined by using this very high dose-rate electron pulse. (auth)

14984 OPTICAL AND KINETIC PROPERTIES OF SEMIREDUCED PLASTOQUINONE AND UBIQUINONE: ELECTRON ACCEPTORS IN PHOTOSYNTHESIS. Bensasson, R.; Land, E. J. (Paris Univ., Orsay, France). Biochim. Biophys. Acta; 325: 175-181(Oct 1973).

Semiquinone anion minus quinone ($\dot{Q}^- - Q$) and neutral semiquinone minus quinone ($\dot{Q}H - Q$) difference spectra were measured for plastoquinone-9, ubiquinone-10, and ubiquinone-0, using pulse radiolysis in methanolic solution. The difference spectra were used to determine the absolute spectra of each semiquinone. The ($\dot{Q}^- - Q$) difference spectrum for plastoquinone-9 is similar to the difference spectrum detected at a time less than 20 ns after flash excitation of the photosynthetic light reaction Photosystem II in spinach chloroplasts [Stiehl, H. H. and Witt, H. T., (1968) Z. Naturforsch. 23b, 220-224; Witt, H. T. (1971) Q. Rev. Biophys. 4, 365-477]. The ubiquinone $\dot{Q}^- - Q$ spectra are similar to difference spectra found on illumination of reaction center preparations from Rhodopseudomonas spheroides and Rhodospirillum rubrum [Slooten, L. (1972) Biochim. Biophys. Acta 275, 208-218; Clayton, R. K. and Straley, S. C. (1972) Biophys, J. 12, 1221-1234]. Ubiquinone has been suggested to be closely associated with the primary electron acceptor of bacterial photosynthesis. Rate constants were measured for formation of semiquinones by reaction $e\dot{C}H_3CH.\dot{C}H_2OH$ and $\dot{C}H_2O^-$ with quinone, and for the decays of the neutral semiquinones. The semiquinone anions were stable for seconds. The ubisemiquinone-6 anion reacts only slowly with oxygen, $k \approx 10^3\ M^{-1} \cdot s^{-1}$. The effect of substituents upon semiquinone physicochemical properties is discussed. (auth)

14985 ESR STUDIES OF RADIATION PROCESSES IN PHOSPHATE GLASSES. Kolditz, L.; Schmidt, H.; Wolf, M.; Stoesser, R. (Univ., Berlin). Z. Anorg. Allg. Chem.; 405: No. 3, 287-298 (May 1974). (In German).

Radiation processes in phosphate glasses were investigated by ESR and optical measurements. ESR shows a hole-center in the systems K_2O/P_2O_5 and $K_2O/MgO/P_2O_5$ which depends on manner and concentration of the cations. Its nature is explained in somewhat a different way than given by Beekenkamp or by Miura and Hasegawa. Another hole-center which is independent of cations is discussed in agreement with optical investigations. The electrons set free by radiation react with O_2 solved in the glass or with cations. The particles Ag^0, Ag^{2+}, Ag_2^+ have been found and Ag_7^{7+} may be present too in the system $K_2O/MgO/Ag_2O/P_2O_5$. The system $K_2O/MgO/Tl_2O/P_2O_5$ shows analogous reactions, but full explanation of the lines could not yet be given. (auth)

14986 RADIATION CHEMICAL PROCESSES: THE WORLD SCENE. Sangster, D. F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). At. Energy Aust.; 17: No. 2, 15-25(Apr 1974).

Radiation chemical processing throughout the world is reviewed. The size of the industry and special centers engaged in radiation processing are described. Applications of radiation processing of polymers include cross linking, polymerization and radiation degradation. Examples of improved physical properties due to radiation processing are described for concretes, textiles, cables, and surface coatings. Other applications include the manufacture of chemicals, waste water treatment and radiation activation of catalysts. (AT)

14987 UNSTABLE INTERMEDIATES. Pt. 144. Organomercury Radicals in Irradiated Alkylmercury(II) Halides and Dimethylmercury. Fullam, B. W.; Symons, M. C. R. (Leicester Univ., Eng.). J. Chem. Soc., Dalton Trans.; No. 10, 1086-1089(1974).

On exposure to ^{60}Co γ rays at 77°K a range of alkylmercury(II) halides give ESR signals indicative of two types of radical: one, exhibiting only small hyperfine interaction with magnetic mercury isotopes, is identified as $R_2\dot{C}HgX$; and the other, with very large hyperfine coupling to mercury, as HgR. Dimethylmercury gives the radical $H_2\dot{C}HgMe$ together with a species thought to be $(Me_2Hg)^{\tau-}$. Structures of these radicals and mechanisms of the processes are discussed. (auth)

14988 RADIATION CHEMISTRY OF POLYETHYLENE. XIII. Alkyl Radical Decay Kinetics in Single Crystalline and Extended-Chain Samples of Linear Polyethylene. Wen, W. Y.; Johnson, D. R.; Dole, M. (Baylor Univ., Waco, TX). Macromolecules; 7: No. 2, 199-204(1974).

The previous kinetic study of alkyl free-radical decay in bulk polyethylene (PE) was broadened to include a study of single crystalline and extended-chain samples of PE. At room temperature and above the decay kinetics can be quantitatively expressed in terms of two simultaneous first-order decay reactions. The catalytic effect of hydrogen gas on the radical decay rate is very much greater in single crystalline PE than in bulk, but the enhanced catalytic activity is in line with the approximately 10-fold greater solubility (per unit of amorphous content) of hydrogen in the single crystal samples. In the extended-chain samples the hydrogen catalytic effect was less than expected. Activation energies decrease with increasing crystallinity of the samples and the activation energies of the fast decay approach those of the slow decay with decreasing crystallinity. (auth)

14989 ESR STUDIES OF TRANSITION METAL IONS IN UNSTABLE OXIDATION STATES. Shock, J. R. East Lansing, MI; Michigan State University (1973). 203p. University Microfilms Order No. 74-6128.

Thesis (Ph. D.).

There are some transition metal ions that form diamagnetic transition metal complexes almost exclusively. In this work, several new paramagnetic species containing these ions in unstable oxidation states have been made either by high-energy irradiation at 77°K or from the melt of alkaline halides containing the diamagnetic transition metal ion. In both cases, the ESR spectra were studied between 77 and 300°K to determine the structure and to characterize the bonding of the resulting paramagnetic species. The γ irradiation of $K_2NbOF_5 \cdot H_2O$ at 77°K produced two ^{93}Nb-centered radicals; one of these is shown to be $[NbOF_5]^{3-}$ with a d^1 configuration and a d_{xy} ground state. The g, $A(^{93}Nb)$, and $A(^{19}F)$ tensors have been completely analyzed in the single crystal at 77°K. The g and metal A tensor for this ion and those found previously for the $[VOF_5]^{3-}$ ion by other investigators were used in a self-consistent charge calculation of molecular orbital coefficients. Also, molecular orbital coefficients were determined from the equatorial fluorine A tensors of these systems. The other Nb-containing ion formed at 77°K is a hole species, thought to be $[NbOF_5]^-$. Warming the sample to 190°K resulted in the decay of the $[NbOF_5]^{3-}$ ion allowing the study of the spectra of the hole species. The analyses of single crystal and powder spectra at 190°K suggest that some $[NbOF_5]^-$ ions remain at 190°K but that the majority of the ions decay to the $NbOF_4$ ion which rotates freely in the matrix. The γ irradiation of $K_3Co(CN)_6$ at 77°K produced two ^{59}Co-containing radicals. A complete single crystal ESR study of the g and $A(^{59}Co)$ tensors for one of these species indicates that it has not undergone appreciable reorientation in the lattice. The g tensor is consistent with a d^7 configuration and a d_{z^2} ground state. Superhyperfine structure from two equivalent nitrogen nuclei and the absence of ^{13}C satellite lines in ^{13}C enriched samples suggest that the axial cyanide ligands have rotated to form nitrogen-to-metal bonds. Also, the $A(^{59}Co)$ tensor of this radical, thought to be $[Co(CN)_4(NC)_2]^{4-}$, was used to estimate the covalency in molecular orbital containing the odd electron. The other Co-containing radical formed at 77°K is considered to be a Co(II) radical pair but its ESR parameters could not be determined. Lastly, the Rh(II) ion in several chloro-complexes was studied. The γ irradiation of $K_3RhCl_6 \cdot H_2O$ at 77°K produced a radical whose g values are consistent with a d^7 system with a d_{z^2} ground state. This radical, thought to be $[RhCl_6]^{4-}$, also appears to form in the melt of AgCl containing $RhCl_3$. In this matrix, the chlorine superhyperfine structure from the two axial chlorines was fully analyzed in the single crystal and the results used to estimate covalency in the complex. Also, γ irradiation of $K_2[RhCl_5(H_2O)]$ at 77°K produced a radical with g values consistent with a d^7 configuration and the unpaired electron in the d_{z^2} orbital. The g values and the chlorine hyperfine splitting from one chlorine suggest that the radical is $[RhCl_5(H_2O)]^{3-}$ or $[RhCl_6]^{3-}$. (Diss. Abstr. Int., B)

14990 RADIATION-INITIATED POLYMERIZATION OF STYRENE IN WAX. Thomas, A. C.; Du Plessis, T. A.; Oosterhuis, A.; Oosterhuis, H. (Atomic Energy Board, Pretoria). Polym. J.; 5: No. 2, 176-180(Nov 1974).

The presence of a paraffin wax was found to considerably reduce the radiation dose required to completely polymerize styrene, but no detectable grafting of styrene to wax occurs. The rate of polymerization was found to be greatly dependent on the styrene/wax composition, and the activation energy was determined to be −7.4 kcal/mole. The addition of scavengers indicates a free-radical mechanism, which is confirmed by preirradiation experiments, showing the wax to be the main source of initiating radicals. The negative activation energy is explained by an induced gel-effect caused by the semirigid wax matrix, which further enhances the polymerization rate, which cannot be accounted for entirely in terms of increased radical production in the wax. (auth)

14991 ACCELERATING EFFECT OF ACETYLENE ON THE GAMMA-RADIATION-INDUCED CROSS-LINKING OF POLYETHYLENE. Mitsui, H. (Japan Atomic Energy Research Inst., Takasaki); Hosoi, F.; Kagiya, T. Polym. J.; 6: No. 1, 20-26(Mar 1974).

The γ-induced crosslinking of polyethylene was investigated in the presence of acetylene under an absolute pressure of 3 kg/cm^2

at 30 to 200°C with a dose rate of 1.1×10^5 rad/hr. The weight of the polyethylene increased almost proportionally to the radiation dose, and the rate of the increase was larger at 30 and 90°C than at 150 and 200°C. The gel fraction increased with rising irradiation temperature, passed through a maximum at around 105°C, and thereafter decreased sharply to become almost constant above 150°C. At temperatures below the melting temperature of polyethylene, the gel fraction was much higher than in vacuo. As a characteristic structural change, the formation of terminal vinyl unsaturation was observed, and the rate of the formation increased with the temperature. The formation of hydrogen and transvinylene unsaturation was little affected by acetylene. On the basis of these results, the role of acetylene in the γ-induced cross-linking of polyethylene is discussed from the view-point of the reaction mechanism. (auth)

14992 PREPARATION OF RADIATION-RESISTANT MATERIALS BY HIGH-PRESSURE RADICAL COPOLYMERIZATION OF ETHYLENE WITH STYRENE. Terteryan, R. A.; Leshchenko, S. S.; Livshits, S. D.; Lelyukhina, Yu. L.; Soboleva, N. S.; Monastyrskii, V. N.; Karpov, V. L. (Scientific-Research Physical Chemistry Inst., Moscow). Vysokomol. Soedin., Ser. B; 16: No. 3, 181-186(Mar 1974). (In Russian).

Copolymerization of ethylene with styrene at 1000-1500 kg/cm² was studied with a view to increasing the radiation resistance of the polyethylene. The results of 25 runs are presented in detail in tabular form and in graphs. (tr-auth)

14993 MECHANISM OF FORMATION OF OXYGEN-CONTAINING GROUPS IN IRRADIATED POLYETHYLENE AND THEIR ROLE IN GRAFT POLYMERIZATION. Dolgova, R. V.; Il'icheva, Z. F.; Akhvlediani, I. G.; Slovokhotova, N. A.; Rozenblyum, N. D. (Scientific-Research Physical Chemistry Inst., Moscow). Vysokomol. Soedin., Ser. B; 16: No. 3, 220-224(Mar 1974). (In Russian).

The results of studies on different stages of the oxidation of irradiated low-density polyethylene for use in graft copolymerization indicated that the first participants in the process are associates of the hydroperoxides and the second, carbonyl groups formed in the radiation oxidation step. (tr-auth)

14994 RADIATION-CHEMICAL YIELDS OF PARAMAGNETIC CENTERS IN POLYMERS. Kiryukhin, V. P.; Milinchuk, V. K. (Physical-Chemistry Inst., Moscow). Vysokomol. Soedin., Ser. A; 16: No. 4, 816-820(Apr 1974). (In Russian).

The radiation-chemical yields of paramagnetic centers at 77°K were measured for 38 synthetic and natural polymers, using an EPR method. Depending on the chemical structure of the polymers, the yields varied from 0.2 to 6. The relation between the yield and the nature of the activation state and between the yield and the difference between the energies of the basic and activated level of the macromolecules was traced. The effect of the isotopic state of the polymer on the yield is discussed. (tr-auth)

14995 ELECTRON PARAMAGNETIC RESONANCE STUDY OF HYDROGEN ATOMS TRAPPED IN γ-IRRADIATED Y TYPE ZEOLITES EXCHANGED WITH DIFFERENT CATIONS. Abou-Kais, A.; Vedrine, J. C.; Massardier, J.; Dalmai-Imelik, G. (CNRS, Villeurbonne, France). J. Chem. Soc., Faraday Trans., I; 70: 1039-1045(1974).

H atoms trapped after the γ-irradiation at 77°K of Y-type zeolites exchanged with different cations have been studied using EPR spectroscopy. The H atom yield is dependent on the acidic structural OH group content and a mechanism of formation and trapping of H atoms is proposed. The H atom yield is related to the acidity and mobility of the hydrogen of the hydroxyl groups and to the trapping strength. The trapping strength of H atoms, characterized by the values of both the hyperfine coupling constant with respect to the free H atom, and the activation energy of recombination, is strongly dependent on the nature of the exchanged cation, and follows the sequence K > Na ≫ Ca > La. (auth)

14996 RADIOLYSIS OF LIQUID DI-N-PROPYL ETHER: ALCOHOL FORMATION AND SOLVATED ELECTRONS. Vermeer, R. A.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Chem.; 52: No. 7, 1181-1187(1 Apr 1974).

In the γ radiolysis of pure di-n-propyl ether at 297°K, G(n-propanol) = 2.5 ± 0.1. The propanol yield was reduced by the addition of an electron scavenger (SF_6) or proton scavenger ($C_5H_7NH_2$), but was not affected by the addition of hydrogen chloride or propylene. In the absence of additives the geminate neutralization reaction $R_2OH^+ + e^-_{solv} \rightarrow ROH + R$ gave 1.8 G units of alcohol. The charge scavenging reactions of SF_6 and $C_5H_7NH_2$ were consistent with the nonhomogeneous kinetics model reported earlier. The optical absorbance of solvated electrons in di-n-propyl ether increased with wavelength up to 1.6 μ, the practical limit of the detector, at all temperatures in the liquid range, including the liquid supercooled to 140°K. The kinetics of electron reactions could be measured by observing the absorption at 0.9 μ. The optical absorbance was consistent with the kinetic model. (auth)

14997 ELECTRON-BEAM-INDUCED POLYMERIZATION OF MONOMERS IN WOOD. I. Effect of Moisture on the Polymerization of Vinyl Monomer in Presoaked Beech-Veneer. Handa, T. (Science Univ. of Tokyo); Otsuka, N.; Akimoto, H.; Ikeda, Y.; Saito, M. Mokuzai Gakkaishi; 19: No. 10, 493-498(Oct 1973). (In Japanese).

Studies have been pursued for the characterization on the effect of moisture content in the polymerization of vinyl monomer impregnated in beech-veneer under electron beam from an accelerator (Van de Graaff type of 1.0 MeV with 20 μ A). The following results have been obtained: (1) Polymerization is primarily concerned with the preswollen internal contact area by moisture, irrespective of the presoaked condition (adsorption and desorption process). The monomer conversion was observed to be proportional to the square root of irradiation dose, and therefore it seems likely that the polymerization in the wood proceeds similarly to the ordinary graft copolymerization. (2) The post-polymerization was observed to be primarily concerned with the increased volume induced by temperature rise in the wood. The conversion in the post-polymerization was increased by a factor of two, when samples were extracted with alcohol-benzene, irrespective of the volume-change. (3) The observed dimensional stability and apparent specific gravity show that the produced polymers remaining after benzene-extraction do not cover the whole active sites for grafting or adsorbed point in the internal contact area. (auth)

14998 FORMATION OF LOW MOLECULAR WEIGHT HYDROCARBONS IN LIQUID N-ALKANES γ-RADIOLYSIS. The Yields Affected by Free Radical and Electron Scavengers. Avdonina, E. N. (Moscow State Univ.). Radiat. Eff.; 20: No. 4, 245-251 (1973).

The data on radical and/or electron scavenger effects on liquid n-alkanes fragmentation by γ-radiation are explained in terms of the decomposition of parent alkyl radicals, resulting at least partly from the process of ion-electron pair neutralization. It is suggested that the decomposition of excited parent radicals in nearly statistical amounts gives rise to practically all olefins with corresponding yields of shorter alkyl radicals (low molecular weight alkanes) and the mechanism of "molecular decomposition" of parent alkane to alkane + olefin does not contribute significantly in n-alkanes fragmentation. Electron scavengers, like N_2O, decrease the yields of parent radicals decomposition products by about only 45%. A certain amount of short alkyl radicals, resulting from other processes is being scavenged in N_2O containing systems. Oxygen scavenges all the radicals complementary to olefins, both scavengeable and unscavengeable, and also radical fraction of another origin, inhibited in N_2O containing systems. (auth)

14999 OPTICAL BLEACHING BEHAVIOR OF NEUTRON IRRADIATED KCl SINGLE CRYSTAL. Suh, I. S. J. Korean Nucl. Soc.; 5: No. 4, 286-290(1973).

Hydroxide-free KCl single crystals were prepared and doped with small amounts of KSH or K_2S. The samples were subjected to neutron irradiations at 77°K in the dark. The irradiated ones were then bleached by a uv lamp and analyzed as four different kinds of chemical forms in ^{35}S whose valence states are −2, 0, 4, and 6. The sulfide fraction of ^{35}S in doped crystals is higher than that in pure crystals. In addition, two distinct patterns in bleaching process up to 30 minutes results in a fast increase in the sulfide fraction and then the sulfide levels off to a slowly increasing region upon prolonged bleaching. The distribution of ^{35}S valence states is described in connection with point defects in the crystals. (Korean Sci. Abstr.)

15000 KINETICS OF OXIDATION OF TRANSITION-METAL IONS BY HALOGEN RADICAL ANIONS. Laurence, G. S.; Thornton, A. T. (Univ., Adelaide). J. Chem. Soc., Dalton Trans.; No. 11, 1142-1148(1974).

The radical ions I_2^-, Br_2^-, and Cl_2^-, generated by nanosecond pulse radiolysis of solutions containing the halide ions, oxidize vanadium(II) to vanadium(III) and chromium(II) to chromium(III). At 22 ± 3°C and I = 0.5 mole l^{-1} rate constants for the reactions $X_2^- + V_{aq}^{2+} \rightarrow V_{aq}^{3+} + 2X^-$ are (1.43 ± 0.2) × 10^9, (1.48 ± 0.2) × 10^9, and (1.95 ± 0.2) × 10^9 l mole^{-1} s^{-1} (X = I, Br, and Cl) and the reaction mechanism is outer sphere in all cases. Corresponding rate constants for the reactions $X_2^- + Cr_{aq}^{2+} \rightarrow [Cr(OH_2)_5X]^{2+} + X^-$ are (1.5 ± 0.2) × 10^9, (1.9 ± 0.2) × 10^8, and (2.4 ± 0.3) × 10^9 l mole^{-1} s^{-1}. The reaction mechanisms were established by gamma-radiolysis and flash-photolysis experiments. The reaction between the ions Cl_2^- and Cr_{aq}^{2+} proceeds by parallel inner- and outer-sphere paths with

approximately equal probability. The radical ions I_2^- and Br_2^- react with Cr_{aq}^{2+} ions entirely by inner-sphere paths. (auth)

15001 ANGULAR DEPENDENCE OF PROTON HYPERFINE SPLITTINGS IN THE ELECTRON SPIN RESONANCE SPECTRUM OF THE METHYLSULFINYL RADICAL. Nishikida, K.; Williams, F. (Univ. of Tennessee, Knoxville). J. Amer. Chem. Soc.; 96: No. 15, 4781-4784(24 Jul 1974).

The methylsulfinyl radical ($CH_3\dot{S}O$) has been identified in a γ-irradiated single crystal of dimethyl sulfoxide. Its electron spin resonance spectrum above −100° shows coupling to three equivalent protons (isotropic quartet hfs = 11.6 G) and to one sulfur atom. The principal values of the g tensor [2.023, 2.011, 2.003] and the ^{33}S hfs tensor [−14, −21, 59 G] confirm this assignment to a sulfur-centered π radical which is isoelectronic with SO_2^-. The spectrum is temperature dependent such that below −185° there is coupling to sulfur and only two equivalent protons (isotropic triplet hfs = 17.3 G). This result shows that the methyl group, which is freely rotating at high temperature, adopts a fixed conformation at low temperature in which one proton lies in the nodal plane of the sulfur 3p orbital which is occupied (ρ_π = 0.91) by the unpaired electron. The conformational dependence of these isotropic proton hyperfine splittings is exactly interpretable by a $\rho_\pi B \cos^2\theta$ relation with B = 25.4 G. (auth)

15002 LOW-TEMPERATURE PULSE RADIOLYSIS. II. Time-Dependent Spectra of Anions of Aromatic Ketones. Hoshino, M.; Arai, S.; Imamura, M. (Inst. of Physical and Chemical Research, Wako, Japan). J. Phys. Chem.; 78: No. 15, 1473-1477 (18 Jul 1974).

Using a pulse radiolysis technique the absorption spectra of anions of acetophenone, benzophenone, and their derivatives were observed in ethanol at 100°K. The spectra obtained immediately after the 0.5-μsec pulse shift toward shorter wavelengths within about 200 μsec. The subsequent spectra are in good accord with those observed for the anions produced by steady γ radiolysis at 77°K. These results indicate that reorientation of solvent molecules around the anion is responsible for the spectral shift in protic solvents. The spectra observed immediately after the pulse are due to the presolvated anions, and the subsequent spectra to the solvated ones. The temperature dependence of the decay of the presolvated benzophenone anion was also studied. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 17378 and 18032.

15003 (COO-3077-53) ELECTRONIC STRUCTURE AND BONDING OF ACTINIDE COMPLEXES. Moskowitz, J. W. (New York Univ., N. Y. (USA). Courant Inst. of Mathematical Sciences). May 1974. Contract AT(11-1)-3077. 23p. Dep. NTIS $4.25.

The electronic structure of actinide complexes was studied. Accurate Hartree−Fock self-consistent-field computations were performed in the recently developed X_α-multiple-scattering approximation. The goal of the investigation is to interpret the optical and magnetic properties of the actinide compounds and to estimate the degree to which covalency must be taken into account in order to understand the role of the 5f electrons in both molecular and metallic bonding. The compounds to be investigated will include the actinyl ions as well as the hexafluoride and oxide complexes of uranium, neptunium, and plutonium. In addition, it is proposed to investigate small metallic clusters that reflect the complex geometry of the unit cell found in the metallic phase of the actinide elements. (auth)

Hot-Atom Chemistry

Refer also to abstract 14930.

15004 YIELDS OF ELEMENTARY REACTIONS INITIATED WHEN HI AND DI ARE ACTIVATED BY 254 nm RADIATION IN 3-METHYLPENTANE-h_{14} AND 3MP-d_{14} AT 20−300°K: H ATOM TRAPPING. Perkey, L.; Willard, J. E. (Univ. of Wisconsin, Madison). J. Chem. Phys.; 60: No. 7, 2732-2740(1 Apr 1974).

Work designed to give a more quantitative understanding of the reactions of hot and thermal hydrogen atoms with hydrocarbons at 298, 77, and 30°K and to explain the absence of trapped H atoms during photolysis of HI in 3-methylpentane-h_{14} (3MP-h_{14}) glass at 30°K is reported. Quantum yields of H_2, HD, and D_2 from the photolysis of HI and DI in 3MP-h_{14} were determined for samples photolyzed in the liquid state at 298°K and the glassy state at 77 and 30°K. The yields of trapped free radicals and of alkyl iodides and iodine were determined on samples photolyzed at 77°K. Trapped hydrogen atoms were produced by photolysis of HI in 3-methylheptane-d_{16} and methylcyclohexane-d_{14} glasses, and their production in 3MP-d_{14} and nonproduction in 3MP-h_{14} confirmed. Photolysis of HI in 3MP-d_{14} at 30°K yields H_2 as well as HD, indicating that thermalized H atoms are produced, but photolysis of DI in 3MP-h_{14} at 30°K yields no D_2. This indicates that all the D atoms produced in 3MP-h_{14} abstract H from C−H bonds and implies that the reason D and H atoms from the photolysis of DI and HI in 3MP-h_{14} are not trapped is because the abstraction reaction consumes all of the atoms before they can be trapped. Information on isotope effects in both the liquid and solid phase was obtained. The data further indicate that: (1) the quantum yield for stabilization of HI (DI) without reaction after having absorbed a photon is about 0.13 at 298°K and 0.5 at 77°K, in either 3MP-h_{14} or 3MP-d_{14}; (2) the yield of HD from HI in 3MP-d_{14} or DI in 3MP-h_{14} at 77°K is much greater than the yield of trapped radicals, implying that $C_6D_{13}I(C_6H_{13}I)$ + HD must be formed by a concerted reaction; (3) at 298°K the reaction D + 3MP-h_{14} competes significantly for thermalized D atoms with the atom scavenging reaction D + DI → D_2 + I at DI concentrations less than ~100 mM. (auth)

15005 EFFECT OF PRELIMINARY IRRADIATION ON RECOIL ATOMS IN IONIC CRYSTALS (KCl-PHOSPHOROUS SYSTEM). Bogdanov, R. V.; Olevskii, E. B. Sov. Radiochem. (Engl. Transl.); 15: No. 4, 590-594(1973).

Translated from Radiokhimiya; 15: No. 4, 590-595(1973).

The reason for the reducing action of preliminary radiation on recoil atoms is the presence of F-centers in the corresponding crystals and their (the F-centers) direct interaction with phosphorus atoms. The indirect mechanism of the action of F-centers and other electronic color centers, which consists of the suppression of oxidation reactions of recoil atoms, plays a lesser role. The concentration and the form of the electron traps in pure KCl crystals has hardly any effect on the radiation chemical conversions and the chemical form of the phosphorus recoil atoms in the proton bombardment process. (auth)

15006 CHEMICAL REACTIONS OF ENERGETIC IODINE ATOMS WITH SIMPLE HYDROCARBONS. Loberg, M. D. Seattle; Washington University (1973). 296p. University Microfilms Order No. 74-7053.

Thesis (Ph.D.).

Iodine atoms formed by the system $^{122}Te(^3He,2n)^{123}Xe$ (2.08 hr half-life) $\xrightarrow{EC/\beta^+}$ ^{123}I (13.3 hr half-life) have been reacted with simple hydrocarbons over a pressure range of 0.07 to 550 atmospheres. Absolute yields were determined throughout this pressure range for the ^{123}I containing organic compounds. In contrast to photochemically produced iodine, it is shown that the hot ^{123}I produced by nuclear activation possesses sufficient energy to form a carbon-iodine bond. With the methane as a substrate, the absolute product yield was 51.8 ± 2.0% $CH_3{}^{123}I$. Evidence is given to show that the $I^+(^3P)$ and $I^+(^1D_2)$ ions are the attacking species in the methane system, and that by the time they react they have come to thermal equilibrium with their surroundings. The higher molecular weight saturated hydrocarbons show reduced organic yields of less than 6%. For these hydrocarbons near-resonance exothermic charge exchange is a possible reaction channel, and it is shown that when such charge exchange reactions are possible, they compete on a faster time scale than the reaction of $^{123}I^+$ with CH_4 to produce $CH_3{}^{123}I$. Evidence indicates that the production of $CH_3{}^{123}I$ from I^+ has a cross section one-sixtieth as large as charge exchange between I^+ and neopentane. Studies on additive-methane systems showed inconsistencies with previous models for the reactions of recoil iodine. A new model involving molecular ion complexes has been developed which is consistent with observed data. This model is characterized by initial complex formation between I^+ and the substrate with the largest gas phase basicity followed by proton transfer to stabilize the vibrationally excited complex. Experimental data have shown that the production of the additive-I^+ complex correlates with the gas phase basicity of the additive. (LK)

15007 BETA-DECAY EFFECTS OF LANTHANIDE ATOMS IN CHELATE COMPOUNDS. Asano, T.; Okada, S.; Sakamoto, K.; Taniguchi, S.; Kobayshi, Y. (Radiation Center of Osaka Prefecture, Saka, Japan). J. Inorg. Nucl. Chem.; 36: No. 7, 1433-1439 (Jul 1974).

The rupture of the metal-ligand bonds associated with β-decay of ^{171}Er and ^{177}Yb have been studied in the Er- and Yb-CyDTA (CyDTA = 1,2 cyclohexanediamine N,N,N',N' tetraacetic acid) chelate compounds. The observed percentage bond ruptures were 70% in ^{177}Yb and 100% in ^{171}Er compounds at pH 6.5. In the ytterbium system, the percentage bond rupture shows an increase with increase of hydrogen ion concentration. On the contrary,

the addition of sodium thiosulfate in both systems results in a decrease in the percentage bond rupture. These results are interpreted in terms of intramolecular electron transfer, multiple ionization and recoil due to the β-decay processes and by the reaction mechanisms such as geminate recombination and proton attack. (auth)

15008 CHEMICAL EFFECTS ACCOMPANYING NUCLEAR ISOMERIC TRANSFORMATION OF $C_2H_5{}^{80m}Br$ IN GASEOUS SYSTEMS. Izawa, G.; Usui, Y.; Shiokawa, T. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 152-157(Dec 1972). (In Japanese).

To study the mechanism of formation of hot ionic bromine products, examinations were made on C_2H_5Br(VB) and 1,2-DBE by the use of $C_2H_5{}^{80m}Br$ as a source of ^{80m}Br. The $C_2H_5{}^{80m}Br$, prepared by reactions of LINAC prepared Na ^{80m}Br, was sealed in an ampoule and kept for about 2 hours in a dark room until irradiation equilibrium was reached. It was then solidified with liquid nitrogen. Extraction was made with CCl_4-sodium sulfite solution. The organic phase was separated into various components using a gas chromatograph. The main products were CH_3Br, C_2H_5Br, and 1,2-DBE. Yield of the CH_3Br was about $\frac{1}{30}$ that of C_2H_5Br. The scavenger effect of oxygen on the hot radical reaction of ^{80}Br was clearly noticed. The addition of krypton to the C_2H_5Br did not affect yield of VB, and the yield of VB was always 2.1%, whereas that of the 1,2-DBE increased up to 8–9% by the addition of more than 40% Kr. The yield of 1,2-DBE was 6.5% when the addition of krypton was less than 40%. The change of total pressure did not affect the yield of VB. The yield of VB was always 2.3%. However, the yield of 1,2-DBE decreased from 8.7% to 3.0% corresponding to the increase of total pressure from 0.5 cm Hg to 50.0 cm Hg. Studies were also made on $H^{80}Br$-C_2H_5Br system. (JA)

15009 SUBSTITUTION REACTIONS OF FISSION-PRODUCED IODINES WITH GASEOUS METHANE AND METHYL HALIDES. Kikuchi, M. Buffalo; State Univ. of New York (1973). 111p. University Microfilms Order No. 74-4415.

Thesis (Ph. D.).

The hydrogen and halogen substitution reactions by three fission-produced iodine isotopes (^{131}I, ^{133}I, and ^{135}I with fractional independent fission yields of 0, 2, and 47%, respectively) with gaseous methane and methyl halides were studied. The sequence of the nuclear and chemical reactions is outlined by the following equations: $^{235}U(n,f)^*I$, $^*I + CH_3X \rightarrow CH_3{}^*I + X$, and $^*I + CH_3X \rightarrow CH_2X^*I + H$ where X may be H, F, Cl, Br, or I. The chemical yield for the directly (or independently) produced *I decreased as the mole fraction of Ar moderator increased, while the yield for the indirectly (via the β^--decay of Te) produced *I was constant. The ratios of the slopes of the Ar moderator curves for the three isotopes and the ratios of the yields at an Ar mole fraction of unity were shown to correlate with the known ratios of the fractional direct and indirect fission yields, respectively. The unimolecular decomposition processes occurring after iodine substitution reactions with gaseous methane demonstrated that iodocarbene was the most common decomposition product. The relative energies of the two spin states of CH*I were determined by studying the reactions of CH*I as a function of Ar pressure, both with, and without O_2. The $^3CH^*I$ made primarily by directly produced *I was the more excited species while $^1CH^*I$ made by the indirectly produced *I was the ground state species. The role of chemical and physical factors controlling the substitution reactions was studied. After the application of corrections for the secondary decomposition of the primary products, it was concluded that the steric effects were the dominant factors for the directly produced *I substitution reactions. The electrostatic interaction followed by the formation of a penta-coordinate intermediate best accounted for the results for the indirectly produced *I reaction. The observed relationship between the chemical reaction probability and the known fractional fission yields suggested that this technique could be used to determine the iodine fractional fission yields for other fissile targets. (Diss. Abstr. Int., B)

15010 THE REACTIONS OF RECOIL TRITIUM ATOMS WITH CYCLOPROPYL BROMIDE. Davanloo, P.; Wai, C. M. (Idaho Univ., Moscow (USA). Dept. of Chemistry). Radiochim. Acta; 19: No. 2, 58-61(1973).

2 tabs.; 16 refs.

Secondary unimolecular isomerization following recoil tritium substitution reactions in gaseous cyclopropyl bromide was investigated. The internal excitation energies in product molecules following T-for-Br and T-for-H substitution reactions in c-C_3H_5Br are discussed. A comparison of recoil T and (n,γ) activated ^{80m}Br reactions with c-C_3H_5Br is given. (GE)

15011 HOT ATOM CHEMISTRY OF Ps-ATOMS IN AQUEOUS SOLUTIONS OF INORGANIC COMPOUNDS. Bartal, L. J.; Ache, H. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemistry). Radiochim. Acta; 19: No. 2, 49-53(1973).

5 figs.; 1 tab.; 19 refs.

The theoretical and experimental aspects of hot positronium reactions with inorganic ions in aqueous solutions leading to a reduction of the latter species are discussed. Experimental data on Pb(II), Sn(II), Cd(II), and Ag(I) ions in aqueous solutions were examined in terms of the kinetic theory of hot reactions. The results suggest that this theory is applicable for hot Ps atoms and it may be used for the evaluation of the parameters that determine the reactivity of hot Ps toward various reactants. Preliminary results presented in this study show only slight differences in the reactivities exhibited by Pb(II), Sn(II), Cd(II), and Ag(I) toward hot Ps. (GE)

15012 A NEW METHOD FOR THE DETERMINATION OF FRACTIONAL FISSION YIELDS: THE REACTIONS OF GASEOUS METHYL IODIDE WITH FISSION-PRODUCED IODINE. Kikuchi, M.; Church, L. B. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Radiochim. Acta; 19: No. 2, 54-58(1973).

2 figs.; 3 tabs.; 25 refs.

The hydrogen substitution reaction by three different fission-produced iodine isotopes (*I) with gaseous CH_3I was studied as a function of their mode of formation. The iodine isotopes are the products of thermal-neutron induced fission of ^{235}U. The yields of the CH_2I^*I products for the directly produced isotopes decrease as the concentration or pressure of Ar moderator increases. This dependence is indicative of a typical hot atom reaction. However, the CH_2I^*I yields from isotopes produced primarily via β^--decay do not change as a function of the moderator concentration. These differences in the observed chemical yields are shown to be quantitatively related to the known direct and indirect fission yields. Thus, this technique could be extended to other fission systems to determine the various fission cross sections by taking advantage of the difference in the chemical reactions. (GE)

15013 EFFECT OF XENON MODERATOR IN HOT HYDROGEN REACTIONS WITH DEUTERIUM HYDRIDE. Hawke, J. G.; Moir, J. (Macquarie Univ., North Ryde, Australia). J. Chem. Soc., Chem. Commun.; No. 12, 490-491(19 Jun 1974).

Kinetic-theory parameters are used to determine the extent to which the hot products from the reaction $T^* + HD$ undergo collisional decomposition; it is shown, using expressions developed recently by Baer and Amiel [J. Chem. Phys.; 53: 407 (1970)] that when xenon moderator is present, collisional decomposition could exceed (70 ± 12)%. (auth)

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Refer also to abstracts 14823, 14865, 15415, 15422, 16115, 16120, 16189, and 17939.

15014 (LA-5515-MS) REACTION BETWEEN PLUTONIUM AND DEUTERIUM. Part I. Rate Measurements by Pressure Changes. Bowersox, D. F. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

The reaction between deuterium gas at pressures less than 500 torr and plutonium coupons at from 25 to 600°C was studied by measuring the change in pressure as the reaction proceeds. Below 250°C, the reaction product of $PuD_{2.7}$ spalled to expose fresh metal and the rate of reaction corresponded to the expression $dQ/dt = k_{11}[A][P_D]$, where Q is the ratio of the gram atoms of deuterium reacted to the initial gram atoms of plutonium, dQ/dt is the change in Q per minute, [A] is the geometrical surface area of the metal coupon, and $[P_D]$ is the deuterium pressure. At temperatures between 250 and 300°C, some product adhered to the parent metal, and above 300°C, an adherent coating was formed with a composition equivalent to $Pu_{2.5}$ or less. Velocity constants were calculated from the data above 330°C by the expression $dQ/dt = k_{39}/Q$. After the adherent coating had formed, rates at these higher temperatures were less than at 100°C. (auth)

15015 (TT-74-50011, pp 255-258) DEVELOPMENT OF A METHOD FOR DETERMINING THE SIZE DISTRIBUTION OF RADIOACTIVE AEROSOLS WITH THE AID OF FILTERING MATERIALS. Ogorodnikov, B. I.; Sitalo, E. A.; Skitovich, V. I.; Konstantinov, I. E. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The efficiency of aerosol trapping by fibrous FP filtering materials depends on the rate of filtration, the diameters of the aerosol particles and of the filter fibers, and the thickness of the filtering layer. Through the right choice of parameters, one can achieve a selective retention of aerosols of a certain size range in the successive layers of filtering material. The filtering char-

acteristics of FPP-3, FPP-70, and FPA-100 materials were determined in the laboratory with aerosols of 0.035 to 0.5 μ particle radius. Linear filtration rates of about 1.5 to 2.0 m/sec were found to be adequate for investigating the size distribution of artificial radioactive aerosols, when the aerosols are mainly trapped by inertial effect. In this case, if FPP-70–0.3 material is used in the front layer and FPP-3–1.2 in the rear, the first filter retains over 95% of the aerosol particles of 0.5μ radius and less than 20% of the particles of about 0.035μ radius. The latter are practically all trapped by the rear filter. Various combinations of layers of FPP-70 and FPP-3 filtering materials were tested while taking radioactive aerosol samples at filtration rates of 1.0 to 1.6 m/sec. Much of the ^{95}Zr, ^{137}Cs and ^{7}Be is bound to particles of 0.2 to 0.25μ average radius. For all isotopes, at least 10% of the overall activity is carried by particles below 0.1μ. (auth)

15016 (TT-74-50011, pp 273-278) MEASURING THE CONCENTRATION OF HIGHLY-DISPERSE RADIOACTIVE AEROSOLS BY THE DIFFUSION METHOD. Kolerskii, S. V.; Kuznetsov, Yu. V.; Lekhtmakher, S. O.; Polev, N. M.; Ruzer, L. S.; Stoyanova, S. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The application of the diffusion method to the determination of the proportion of free atoms and of all the ultrahighly disperse aerosols (molecular complexes) formed through interaction of free atoms with the molecules of the various gases in the air, in the overall concentration of radioactive aerosols of emanation daughter products in the air is discussed. The coefficient of deposition of ultrahighly disperse particles in a cylindrical channel, calculated from formulas of Gormley and Kennedy, is shown to be affected by an error of 3 to 5% at most, due to the fact that the variable distribution of flow velocities in the inflow section of the channel is disregarded in the formulas. The errors of the method are discussed, and the method is shown to facilitate reliable measurements of the proportion of ultrahighly disperse radioactive aerosols of emanation daughter products, if this proportion is at least 10 to 20%. (auth)

15017 DECONTAMINATION OF OBSOLETE PROCESSING FACILITIES AT HANFORD. Foster, C. B.; Szulinski, M. J. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 77-78(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15018 NUMBER OF ATOMS FORMED PER ION PAIR IN TRITIUM GAS. Correlation with Molecular Processes. Jones, W. M.; Dever, D. F. (Univ. of California, Los Angeles). J. Chem. Phys.; 60: No. 7, 2900-2906(1 Apr 1974).

The number of atoms formed per ion pair by the β particles in tritium gas was determined to be $M_0 = 5.1 \pm 0.3$ by capture of the atoms on a surface of molybdenum trioxide at 22, 40, 60, and 100°C and from 8 to 211 torr. Correction was made for a decrease in the measured number of atoms per ion pair with increasing pressure. The effect was interpreted as resulting from a competition between capture of atoms by MoO_3 and surface recombination, with the former dominating at low pressure. Atoms are formed by $T_2^+ + T_2 \rightarrow T_3^+ + T$ (R1) and $T_3^+ + e^- \rightarrow T_2 + T$ (R2), by $T_3^+ + e^- \rightarrow 3T$ (R2′) to at most a minor extent, and by excitation of triplet and subsequently quenched singlet molecular states. The number of atoms resulting from dissociative recombination of H_3^+ (n_r) was found to be approximately one by reconsidering the conditions of an experiment of Corrigan. This value of n_r and previous calculations of the numbers of triplet and singlet excitations per ion pair were used to deduce $M_0 = 4.8$, in reasonable agreement with experiment. (auth)

15019 REACTION OF VANADIUM TETRACHLORIDE WITH HIGH-AREA THORIUM OXIDE. Martin, B. W. Jr. Gainesville, FL; Univ. of Florida (1973). 105p. University Microfilms Order No. 74-9556.

Thesis (Ph.D.).

High-area thorium oxide was prepared by precipitation of the hydrous oxide from thorium nitrate solution. The surface area ranged from 78 to 97 m^2g^{-1}. The thoria samples were then degassed by heating to 600°C for 4 hours under a vacuum of about 5×10^{-4} mm Hg. Employing a gravimetric procedure, it was estimated that about 4 hydroxyl groups per nm^2 remained after this degassing process. Vanadium tetrachloride was then permitted to react with the surface hydroxyl groups. In some cases this reaction was preceded by the addition of water, which reacted with the surface to form additional hydroxyl groups. Electron spin resonance spectroscopy was then used to study the paramagnetic vanadium surface species. Two items of information were obtained from the spectra, the line intensities and shapes. The analysis of the spectral intensities led to the conclusions that the unreacted vanadium tetrachloride did not contribute to the spectrum, and that it did not react unless sufficient hydroxyl groups were present on the surface. The superexchange interaction between neighboring vanadium species caused the axially symmetric spectrum to collapse as the exchange interaction increased until an exchange narrowed singlet resulted. A computer program was written to simulate the experimental spectra based on the Anderson-Kubo theory to describe the collapse of the hyperfine multiplet, and on a stochastic theory developed by Jensen to describe the effects of exchange on an anisotropy broadened electron spin resonance line. By a comparison of the experimental results with the simulated spectra it was possible to estimate the exchange interaction for some of the spectra, which suggested that the vanadium species were bonded to the surface through reaction with two hydroxyl groups for each vanadium atom. (Diss. Abstr. Int., B)

15020 INTERACTION OF URANYL SULFATE WITH NEUTRAL LIGANDS. Shchelokov, R. N.; Orlova, I. M.; Podnebesnova, G. V. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 5, 1369-1374(May 1974). (In Russian).

The complex compounds $[UO_2SO_4L_2]$ and $[UO_2SO_4L'_2]$ were synthesized, where L is dimethyl formamide, dimethyl sulfoxide, or tetramethyl urea and L′ is antipyrin or glycocol. It was shown that the action of the neutral ligands used on uranyl sulfate in solution did not lead to a displacement of the sulfate group from the inner sphere of the initial compound. The structure of the product complexes is discussed. (tr-auth)

15021 INTERACTION OF URANYL TRIHYDROXYQUINOLATE WITH OXALIC ACID. In'kova, E. N.; Arsent'eva, V. P. Zh. Neorg. Khim.; 19: No. 5, 1364-1368(May 1974). (In Russian).

A new complex, $(oxine\ H)_2(UO_2)_2(C_2O_4)_3 \cdot (oxine)_2(H_2O)_2$, was prepared (oxine = ortho-hydroxyquinoline, C_9H_7ON and oxine $H^+ = C_9H_8ON^+$). Potentiometric titration, infrared spectra, and data from thermogravimetric analysis showed that two molecules of hydroxyquinoline coordination bond with the uranyl group and two others enter into the composition of the compound as the cation oxine H^+, not bound directly to the uranyl. The isolated compound belongs to a new branch of the uranyl trihydroxylate series. (tr-auth)

15022 REDOX POTENTIALS AND ELECTRONIC STRUCTURE OF 4f AND 5f ELEMENTS. David, F. (Paris Univ., Orsay, France). Rev. Chim. Miner.; 10: No. 4, 565-576(1973). (In French).

The redox properties of 4f and 5f elements are compared and discussed. The variation in free redox enthalpy with degree of oxidation occurs as with d elements: linear function when ions of the same electron configuration are considered. In contrast, the stability variations of the state of oxidation with Z for $91 \leq Z \leq 103$ elements demonstrate the existence of a distinct series of elements behaving very differently from d elements. (FR)

15023 ION EXCHANGE STUDY OF THE SULPHATE COMPLEXES OF PLUTONIUM(IV). Fardy, J. J.; Pearson, J. M. (Australia Atomic Energy Commission Research Establishment, Lucas Heights). J. Inorg. Nucl. Chem.; 36: No. 3, 671-677(Mar 1974).

The sulfato complexes of plutonium(IV) were studied at 25°C in 1 and 2 M perchloric acid media using the ion-exchange method of Fronaeus. Beta liquid scintillation counting of the ^{241}Pu normally present in plutonium samples was used to measure the distribution of plutonium between resin and solution to avoid interference from the alpha-active ^{241}Am. Valence instability caused problems until solutions were stabilized by the addition of nitrite ion. Only two complexes, $PuSO_4^{2+}$ and $Pu(SO_4)_2$, were formed in the range of ligand concentration investigated, 5.0×10^{-3} to 0.2 M HSO_4^-. The stability constants for the complex equilibria $Pu^4 + nHSO_4^- \rightleftharpoons Pu(SO_4)_n^{4-2n} + nH^+$ in an acid perchlorate medium of ionic strength I = 2, are $\beta_1^* = 556 \pm 16$ and $\beta_2^* = (27.2 \pm 0.8) \times 10^3$. Stability constants of the sulfato complexes of the tetravalent actinides are tabulated and compared. The stability sequence $Th^{4+} < U^{4+} > Np^{4+} < Pu^{4+}$ generally follows the simple electrostatic model, with the reversal of the Np^{4+} being attributed to changes in the shape and size of the hydration shell. (auth)

15024 STABILITY CONSTANTS OF THE COMPLEXES OF SUBSTITUTED 8-AMINO-1-NAPHTHOLS WITH UO_2^{2+} Cu^{2+}, Ni^{2+}, Co^{2+}, Zn^{2+}, Cd^{2+}, Mn^{2+}, and Mg^{2+}. Vartak, D. G.; Jose, C. J. (Bhabha Atomic Research Center, Bombay). Indian J. Chem.; 2: No. 12, 1306-1308(Dec 1973).

The metal-ligand stability constants of the complexes of the closely related ligands viz. 8-amino-1-naphthol, and its 5-sul-

fonic acid, 2,5-disulphonic acid, 3,5-disulphonic acid, and 3,6-disulphonic acid derivatives with UO_2^{2+}, Cu^{2+} Ni^{2+}, Co^{2+}, Zn^{2+}, Cd^{2+}, Mn^{2+}, and Mg^{2+} were evaluated using Calvin-Bjerrum pH titration technique at μ = 0.1 M ($NaClO_4$). Contrary to usual observations the order of stability constants UO_2 > Cu is observed in the present studies. The order followed with respect to other metal ions is Ni > Mn > Co > Zn > Mg > Cd. (auth)

15025 QUALITY CONTROL OF RADIOACTIVE PRODUCTS FOR PATIENT ADMINISTRATION AT THE NATIONAL INSTITUTES OF HEALTH. Vacca, P. C.; Farkas, R. J.; Semler, M. O. (National Inst. of Health, Bethesda, MD). J. Label. Compounds; 9: No. 4, 755-768(1973).

From problems in the purity of labelled compounds; New York, NY (28 Aug 1972).

Quality control procedures for radioactive materials destined for patient use at the National Institutes of Health are described. The Radiopharmaceutical Section is responsible for attesting to pharmaceutical quality, while the Radiation Safety Section performs per-unit-volume assays and radionuclidic purity checks on these materials. Types and examples of product error are presented as well as statistical data on assay discrepancies. The frequency of error during the past ten years indicates the necessity of continued quality control testing of all radioactive materials, regardless of source of supply and prior administration to patients. (auth)

15026 SPECIFICATIONS AND CRITERIA FOR THE QUALITY CONTROL OF LABELLED CHEMICALS. Harris, W. G.; Baroosbian, A. V. (New England Nuclear Corp., Boston). J. Label. Compounds; 9: No. 4, 743-754(1973).

From problems in the purity of labelled compounds; New York, NY (28 Aug 1972).

The primary objective of the supplier of labelled chemicals is to provide the investigator with a product of the highest quality attainable. Ultimately, however, the specific requirement of purity is dictated by experimental design. As new and highly sophisticated experimental procedures are developed, the demand for expertise on the part of both supplier and investigator increases. Exhaustive analyses are required by the manufacturer to provide the investigator with assurance that a given product will fulfill all of his experimental criteria. The final responsibility as to the purity of a given labelled product for a specific application must be based on a careful evaluation by the investigator himself. (auth)

15027 IR AND RAMAN STUDIES ON THORIUM PEROXIDE. Raman, V.; Jere, G. V. (Indian Inst. of Tech., New Delhi). Indian J. Chem.: 2: No. 12, 1318-1319(Dec 1973).

Thorium peroxide samples obtained from nitrate medium were subjected to ir and Raman studies to examine the nature of nitrate and peroxo groups. It was found that nitrate associated with the solid samples of thorium peroxide is present as a free ion (D_{3h}) and not coordinated to thorium (C_{2v}). Peroxo group is of bridging type and stable. (auth)

15028 STABILITY CONSTANTS OF COMPLEXES OF p-(MERCAPTOACETAMIDO)CHLOROBENZENE WITH Zn(II), VO(II), UO_2(II) AND Be(II). Kakkar, S. N.; Khadikar, P. V. (Vikram Univ., Ujjain, India). Indian J. Chem.; 2: No. 12, 1325-1326 (Dec 1973).

The proton ligand formation constant of p-(mercaptoacetamido) chlorobenzene and stepwise formation constants of its complexes with Zn(II), VO(II), UO_2(II), and Be(II) were determined by Irving-Rossotti method. The order of stability is found to be Zn(II) > VO(II) > Be(II) > UO_2(II). The metal ligand bonding is discussed in terms of π-interaction. (auth)

15029 SPECTROSCOPIC STUDIES OF THE NATURE OF THE COORDINATION OF THE OXALATE GROUP BY THE URANYL GROUP. Shchelokov, R. N.; Karasev, V. E. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 15: No. 5, 1424-1427(May 1974). (In Russian).

The results of infrared absorption spectrum studies on a number of uranyl compounds containing the oxalate group are presented and the data are interpreted. (tr-auth)

15030 MAGNETIC AND SPECTROSCOPIC PROPERTIES OF URANIUM(IV) ACETATE. Jezowska-Trzebiatowska, B.; Janczak, C. K.; Muiak, J. Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 22: No. 3, 235-239(Apr 1974).

The magnetic susceptibility measurements were carried out on uranium(IV) acetate over the temperature range 296°K and diffuse reflectance spectra were obtained at room temperature over the region 11800–25000 cm^{-1}. On the basis of the temperature vs. magnetic susceptibility relationship it was concluded that the ground state of the U^{4+} ion in this compound is a system of two singlets about 90 cm^{-1} apart, formed by splitting of the $|\pm 3\rangle$ doublet of term $^3H_4$. (auth)

15031 MECHANISM OF PROTON RELAXATION IN AQUEOUS SOLUTIONS OF Pu(IV). Vdovenko, V. M.; Kolokol'tsov, V. B.; Stebunov, O. B. Sov. Radiochem. (Engl. Transl.); 15: No. 4, 612-613(1973).

Translated from Radiokhimiya; 15: No. 4, 612-614(1973).

Proton relaxation in aqueous solutions of tetravalent plutonium is determined to a considerable degree by the interaction of paramagnetic Pu(IV) ions with water molecules outside the region of closest hydration. The dwell time of water molecules in the first hydration envelopes of plutonium(IV) ions was estimated. (auth)

15032 PRODUCTS FROM REDUCTION OF γ-U_3O_7 WITH HYDROGEN. Kuz'micheva, E. U.; Komarevtseva, N. I.; Kovba, L. M. Sov. Radiochem. (Engl. Transl.); 15: No. 4, 614-615(1973).

Translated from Radiokhimiya; 15: No. 4, 614-615(1973).

The phase composition of the products from the reduction of the tetragonal oxide γ-U_3O_7 by hydrogen in the temperature range 300 to 425°C was studied. A series of discrete phases β-U_3O_7, U_4O_9, and UO_{2+x} ($x \approx 0.02$) was formed. Together with the reduction there was a thermal decomposition of the γ-U_3O_7 (but at a much lower rate). (LK)

15033 THERMODYNAMICS OF PLUTONIUM AND URANIUM IN LIQUID ALLOYS AND APPLICATION TO PYROCHEMICAL REPROCESSING OF FAST BREEDER REACTOR FUELS. Johnson, I. (Argonne National Lab., IL). J. Nucl. Mater.; 51: No. 1, 163-177(May 1974).

A method is presented for the estimation of the solubility of uranium and plutonium in solvent systems composed of two or more low-melting metals. The method presented for the estimation of the activity coefficient of uranium and plutonium in multicomponent solvent systems is applicable to the prediction of solubilities and of distribution coefficients between liquid alloys and molten salts. The theoretical basis for the salt transport separation process used in pyrochemical methods for the recovery of irradiated fast breeder reactor fuels is presented. The methods are illustrated by the computation of the solubility of uranium in liquid Zn-Mg and Zn-Mg-Ca alloys and the distribution of uranium between liquid Zn-Mg alloy and molten $MgCl_2$. (auth)

15034 DETERMINATION OF PURITY OF SOME TRITIATED STEROIDS. Merill, E. J.; Vernice, G. G. (Hoffman-La Roche, Inc., Nutley, NJ). J. Label. Compounds; 9: No. 4, 769-777(1973).

From problems in the purity of labelled compounds; New York, NY (28 Aug 1972).

When radiolabelled steroids at high specific activities are required for biological studies, the particular requirements of purity must be determined. The analyses to which the compound is subjected is based on these requirements. Analytical methods are complicated because of the radiochemical instability and the lack of sufficient sample. Methods have been developed which will allow ir and uv spectra to be determined with subsequent recovery of the sample. A prime requisite for this is specially purified solvents. The acceptability of certain solvents for this use can be determined by concentrating an aliquot of the solvent and then examining the residue by TLC. Spraying the developed chromatogram with a 5% solution of phosphomolybdic acid in ethanol, followed by heating will reveal the presence of impurities in the solvents. These impurities appear as spots and can readily be misinterpreted as contaminants in the sample if unpurified solvents are used to manipulate a pure steroid. Problems associated with the determination of radiochemical purity via GLC and TLC will be discussed. The synthesis of tritiated ethynyl estradiol its cyclopentyl ether, and the cyclopentyl ether of norethindrone acetate will illustrate the above problems. (auth)

15035 DEVELOPMENT OF SPECIFICATIONS FOR LABELLED NUCLEOTIDES AND RELATED COMPOUNDS. Specific Activity Measurements by Mass Spectrometry. Goldstein, G.; Rainey, W. T. (Oak Ridge National Lab., TN). J. Label. Compounds; 9: No. 4, 805-815(1973).

From problems in the purity of labelled compounds; New York, NY (28 Aug 1972).

The National Academy of Science-National Research Council Committee on Specifications and Criteria for Biochemical Compounds is considering the problems involved in preparing specifications for labelled biochemicals. The Subcommittee on Nucleotides and Related Compounds has examined methods for specific activity measurement. We find that the specific activity of ^{14}C-labelled purines and pyrimidines can be determined accurately and precisely by mass spectrometry. Moreover, from the known fragmentation patterns and the isotopic abundance of ^{14}C in the

fragments, the position of the labelled atoms can often be established and the labelling pattern in "uniformly labelled" compounds described. In two of the five compounds tested, the specific activity determined by mass spectrometry was 20% higher than the quoted value. (auth)

15036 CONTROL OF RADIOCHEMICAL PURITY OF SODIUM OXALATE-^{14}C PREPARATIONS. Antosik, B.; Nowak, K. (Instytut Badan Jadrowych, Swierk, Poland). Nukleonika; 19: No. 4, 315-321(1974). (In Polish).

A rapid method of radiochemical purity control of sodium oxalate-^{14}C on Whatman ET-81 chromatography paper by developing with 0.125 M sodium chloride is elaborated. During the 2.5-hr developing-time the solvent front reaches 20 cm. R_F values of carbonate and propionate expected as radiochemical impurities are respectively 0.60 and 0.82; R_F value of oxalate is 0.42. It has been found that the sodium oxalate-^{14}C preparations after dissolving in water decompose very slowly and they can be analyzed even 3 days after dissolving. Accuracy of the determination of oxalate ranging from 75-100% is 0.9%, carbonate in quantities to 5% is 0.4% and propionate in quantities to 25% is 0.9%. (auth)

15037 PREPARATION OF ^{99m}Tc-EDTA COMPLEXES OF HIGH SPECIFIC ACTIVITY. Vrana, V.; Kleisner, L.; Cechova, J. (Charles Univ., Prague). Cas. Lek. Cesk.; 112: No. 15, 467-470(13 Apr 1973). (In Czech).

Preparation of ^{99m}Tc-DTPA and ^{99m}Tc-EDTA complexes is described in an effort to produce ready-made preparations suitable for use in scintigraphy. The preparation of the complexes was based on the ^{99m}Tc bond to the precipitate of iron hydroxide. The resulting substance had a volume of 1 ml, pH of 4.5, more than 95% of activity in the form of complex and less than 2% of activity in the form of free pertechnetate. The respective ingredients needed for the preparation of the complexes could be stored in cold and dark for three months. (Nuclear Sci. Abstr. Czech.).

15038 PLUTONIUM(IV) FLUORIDE-THALLIUM(I) FLUORIDE SYSTEM. Jove, J.; Pages, M.; Freundlich, W. (Institut du Radium, Paris). Compt. Rend., Ser. D; 278: No. 12, 873-874(18 Mar 1974). (In French).

The existence of the following five new phases was established: Tl_4PuF_8, Tl_3PuF_7, Tl_2PuF_6, $TlPu_6F_{31}$ and $TlPu_3F_{13}$. They correspond, respectively, to the following molar ratios 4/1, 3/1, 2/1, 7/6 and 1/3. Three of them were indexed from their structural similarities with the corresponding uranium or neptunium compounds. (FR)

15039 ABSORPTION SPECTROPHOTOMETRIC STUDY OF THE EQUILIBRIUM $Pu^{4+} + Cl^- \rightleftharpoons Pu^{3+} + \frac{1}{2} Cl_2$ IN FUSED LiCl-KCl EUTECTIC. Landresse, G.; Duyckaerts, G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 10: No. 8, 675-683(Aug 1974). (In French).

Quantitative study of the equilibrium $Pu^{4+} + Cl^- \rightleftharpoons Pu^{3+} + \frac{1}{2} Cl_2$ in the eutectic LiCl-KCl at 400, 450, 500 and 550°C by absorption spectrophotometry made it possible to calculate the equilibrium constant of the reaction. Values were deduced for thermodynamic quantities ($\overline{\Delta}H = 36 \pm 3$ kJ mole^{-1} and $\overline{\Delta}S = 46 \pm 4$ J mole^{-1} K^{-1}) and for the standard potential of the Pu^{4+}/Pu^{3+} couple $E^0_{Pu^{4+}/Pu^{3+}} - E^0_{Cl_2/Cl^-} = -0.050 \pm 0.006$ volts at 400°C). (auth)

15040 HEAT CAPACITY OF URANIUM PHOSPHIDES ABOVE ROOM TEMPERATURE. Ono, F.; Kanno, M.; Mukaibo, T. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 12, 764-765(Dec 1973).

Heat capacities of uranium phosphides determined by means of double-adiabatic high-temperature calorimeter in the temperature range between 400 and 900°K for UP, and between 400 and 800°K for U_3P_4 are reported. (LK)

15041 STUDY OF FLUORIDE COMPOUNDS OF ZIRCONIUM AND TRIVALENT URANIUM. Fonteneau, G.; Lucas, J. (Rennes Univ., France). J. Inorg. Nucl. Chem.; 36: No. 7, 1515-1519 (Jul 1974). (In French).

A new compound of trivalent uranium $UZrF_7$ has been synthetized. This compound, isotypic with $SmZrF_7$, crystallizes in a monoclinic system. A new compound UZr_2F_{11} was found in the systematic study of the binary system $UZrF_7$-ZrF_4. These two fluorides containing U(III) oxidize slowly at room temperature. Magnetic measurements are consistent with the presence of uranium(III) in these two compounds. (auth)

15042 ELECTRONIC ABSORPTION SPECTRA OF SOLUTIONS OF HETEROPOLYMOLYBDIC ACIDS OF CERIUM, THORIUM, AND URANIUM(VI). Kazanskii, L. P.; Torchenkova, E. A.; Spirin, V. I. (Moscow State Univ.). Dokl. Phys. Chem.; 213: No. 1-3, 932-934(Nov 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 1, 118-121 (Nov 1973).

The spectra of heteropoly compounds of Ce(IV), Th(IV), and U(IV) have three absorption bands in the uv region. It has been shown by Raman and ir spectroscopy that the anions of these acids have the same structure and that it is preserved in aqueous solutions. A scheme of molecular orbitals is proposed and from this the absorption bands of solutions of heteropoly compounds of cerium, thorium, and uranium(IV) in the uv region can be assigned to $p_\pi \rightarrow d_\pi$ transfer. (LK)

15043 VIBRATIONAL SPECTRA AND STRUCTURE OF HYDRATED URANYL SALTS. Caville, C.; Poulet, H. (Univ., Paris). J. Inorg. Nucl. Chem.; 36: No. 7, 1581-1587(Jul 1974). (In French).

Raman spectra of single hydrated crystals and ir absorption spectra of powders of uranyl salts were obtained at room temperature. Raman spectra of uranyl nitrate hexahydrate agree with the neutron determined structure and show without ambiguity two sets of crystallographically non-equivalent nitrate groups. The Raman spectra of uranyl chloride trihydrate cannot be interpreted in the centrosymmetric structure derived by x-rays; this was checked by pyro- and piezo-electric probes. Raman spectra of uranyl acetate dihydrate are used to correct some misassignments made in a previous ir study, and give some indications in favor of one of the proposed space groups. (auth)

15044 REDUCTION OF URANIUM DIOXIDE-MAGNESIUM OXIDE SOLID SOLUTIONS. Ainscough, J. B.; Rigby, F. (United Kingdom Atomic Energy Authority, Springfields, Eng.). J. Inorg. Nucl. Chem.; 36: No. 7, 1531-1534(Jul 1974).

Compacted mixtures of UO_2 and MgO with Mg/U ratios up to 0.07 readily form solid solutions when heated at 1600° in a slightly oxidizing atmosphere such as a 5% H_2-95% CO_2 mixture. No oxygen vacancies are associated with these solid solutions which can always be represented as $U_xMg_{1-x}O_{1+z}$ where z cannot be negative. The reduction of these solid solutions has been studied. The amount of magnesium remaining in solution depends not only on the oxygen potential of the reducing gas but also on the concentration of dissolved magnesium prior to reduction. This concentration effect is most marked at the higher concentrations of dissolved magnesia. It is shown that the quantity of magnesia which can be dissolved in UO_2 at a given oxygen potential is less than the quantity retained in solution when a solid solution, prepared in a more oxidizing atmosphere, is reduced at that oxygen potential. Magnesia precipitates from solution during reduction in the form of small clusters which are distributed both inter- and intragranularly in the compacts. (auth)

15045 RECENT DEVELOPMENTS IN THE CHROMATOGRAPHIC ANALYSIS AND PURIFICATION OF RADIOACTIVELY LABELLED LIPIDS. Mukherjee, K. D.; Mangold, H. K. (Bundesanstalt fuer Fettforschung, Muenster, Ger.). J. Label. Compounds; 9: No. 4, 779-803(1973).

From problems in the purity of labelled compounds; New York, NY (28 Aug 1972).

Methods for the analysis and purification of lipophilic substances labelled with ^3H or ^{14}C are outlined. The necessity of using various techniques based on complementary principles is emphasized. In addition, new developments in instrumentation for the quantitative analysis and preparative isolation of labelled substances are described. (auth)

15046 POSSIBILITY OF THE OXIDATION OF Cm(III) AND Pr(III) TO THE TETRAVALENT STATE IN AQUEOUS SOLUTIONS. Myasoedov, B. F.; Lebedev, I. A.; Mikhailov, V. M.; Frenkel, V. Ya. (Inst of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 17: No. 5-6, 359-365(30 Jun 1974).

Anodic oxidation of Pr(III) in 8M HNO_3 and 15M H_3PO_4, as well as oxidation by ozone in 10M HNO_3, 15M H_3PO_4 and 50% K_2CO_3 solutions does not yield Pr(IV). On the other hand, introduction of a large amount of ^{244}Cm into a 15M H_3PO_4 solution does not hinder the electrochemical oxidation of Am(III) and slightly decreases the stability of Am(IV) having been formed. These results indicate that the electrochemical oxidation of Cm(III) in 15M H_3PO_4 does not occur owing to the great redox potential of the Cm(IV)-Cm(III) couple and not because of radiolysis. (auth)

15047 DEUTERIZATION OF URANIUM. Pivarc, J. (Inst. of Physics, Bratislava). Radiochem. Radioanal. Lett.; 17: No. 5-6, 367-374(30 Jun 1974).

The deuterization of uranium swarf and uranium powder is investigated and an explanation for the differences in the deuteriza-

tion of both is given. An influence of the initial pressure of deuterium on the rate of deuterization of uranium powder is shown. The uranium forms UD_3 with deuterium which has similar properties to UH_3. The apparatus used in the experiments is also described. (auth)

15048 PHOTOREDUCTION OF THE URANYL ION WITH LASER LIGHT AND ETHANOL. 1. Quantum Yields and Medium Effects. Bell, J. T.; Buxton, S. R. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 36: No. 7, 1575-1579(Jul 1974).

The photoreduction of the uranyl ion in sulfuric acid with laser light and ethanol is discussed. Quantum yields of ~0.6 and 0.5 were measured for the production of U(IV) with an argon ion laser and with the neon laser, respectively. The effects of ethanol and sulfuric acid concentrations to increase the quantum yields are discussed. (auth)

15049 THERMAL DECOMPOSITION OF AMMONIUM DIURANATE. Ball, M. C.; Birkett, C. R. G.; Brown, D. S.; Jaycock, M. J. (Loughborough Univ. of Tech., Eng.). J. Inorg. Nucl. Chem.; 36: No. 7, 1527-1529(Jul 1974).

Thermogravimetry has been used to suggest a formula for ammonium diuranate (ADU). The kinetics and mechanisms of the three stages in its decomposition to U_3O_8 have been elucidated and activation energies derived. The overall process can be written $UO_3 \cdot NH_3 \cdot 2H_2O \rightarrow UO_3 \cdot 2H_2O \rightarrow UO_3 \rightarrow U_3O_8$. The chemical changes have been correlated with changes in surface area. (auth)

15050 SPECTROPHOTOMETRIC INVESTIGATION OF THE URANIUM(IV) COMPLEXES IN AQUEOUS-ORGANIC NITRIC ACID SOLUTIONS. Juenger, E.; Schmid, E. R. (Vienna Univ. (Austria). Analytisches Inst.). Radiochim. Acta; 19: No. 2, 75-83(1973). (In German).

3 figs.; 10 tabs.; 18 refs.

The complexes of uranium(IV) in mixed aqueous–organic nitric acid solutions were investigated by a spectrophotometric method in the range of 400 to 700 nm. Organic solvents used were methanol, ethanol, i-propanol, and acetone. The determination of the dependence of molar extinction coefficients of characteristic peaks on (a) the nitric acid concentration, (b) the kind of organic solvent, (c) the concentration of the organic solvent, and (d) the observation of isobestic points indicate that: (1) in mixed aqueous–organic nitric acid solutions of uranium(IV), no organic solvent molecules enter the primary solvation sphere of the cation; (2) addition of organic solvent shifts the uranium complex equilibrium to the side of neutral and anionic nitrato complexes; (3) the ability of the organic solvent to shift the complex equilibrium in that direction increases in the sequence methanol < ethanol < acetone. The dependence of the ratio of uranium(IV)-hexanitrato complex on the kind and concentration of the organic solvent and the nitric acid concentration was determined. (GE)

15051 PREDICTION OF PROPERTIES OF THE ALKYL COMPOUNDS OF THE ELEMENTS 112, 114, ASTATINE, AND ELEMENT 117. Hoffmann, P. (Technische Univ. Darmstadt (F. R. Germany). Fachbereich Anorganische Chemie und Kernchemie). Radiochim. Acta; 19: No. 2, 69-75(1973). (In German).

10 figs.; 7 tabs.; 35 refs.

Using extrapolation methods, the following properties were determined for previously unknown methyl and ethyl compounds of the super heavy elements 112, 114, 117, and of astatine: binding energy for $112(CH_3)_2$, $114(CH_3)_4$, $117CH_3$, and $AtCH_3$; atomic heat of formation and dissociation energy for $114(CH_3)_4$; heat of evaporation, plot of vapor pressure, and boiling point for $114(CH_3)_4$, $117CH_3$, and $AtCH_3$; and ionization potential for $114(CH_3)_4$, $117CH_3$, $117C_2H_5$, as well as for $AtCH_3$ and AtC_2H_5. (GE)

15052 THE CHEMISTRY OF URANYLVANADATES WITH TRIMETAVANADATE IONS AND LAYER STRUCTURE (UVANITE). P. 2. Uvanite With Organic Interlayer Cations and Its Intercalation Complexes With n-alkylamines and n-alkanols. Beneke, K.; Grosse-Brauckmann, U.; Lagaly, G.; Weiss, A. (Muenchen Univ. (F. R. Germany). Inst. fuer Anorganische Chemie). Z. Naturforsch., B; 28: No. 7-8, 408-415(Jul 1973). (In German).

5 figs.; 1 tab.; 9 refs.

The interlayer cations of uvanite can be exchanged quantitatively by n-alkylammonium ions. In the stoichiometric compounds the alkyl chains of the cations (n = 6 to 18) are poorly ordered in monolayers and oriented nearly perpendicular to the uranyltrimetavanadate layers though the space filling is unfavorable with this arrangement. During the cation exchange at pH = 7 to 9 additional free amine molecules are taken up yielding 1:1 intercalation complexes $(C_nH_{2n+1}NH_3)$ $(C_nH_{2n+1}NH_2)$ $[UO_2V_3O_8]$ with close-packed, well ordered monolayers of alkyl compounds. With excess of pure amines or pure alkanols 1:3 intercalation complexes (n,n' = 6 to 18) are formed with the alkyl chains ordered to bimolecular layers. These complexes rearrange at higher temperature into new phases as a consequence of rotational isomerization of the alkyl chains. (GE)

15053 MIXED LIGAND AMINO ACID CHELATES OF THORIUM(IV). Tewari, R. C.; Srivastava, M. N. (Univ. of Allahabad, India). Indian J. Chem.; 11: No. 11, 1196-1198(Nov 1973).

Mixed ligand 1:1:1 chelates of Th(IV) containing EDTA as primary ligand and amino acids such as glycine, alanine, valine, etc., as secondary ligands, were studied potentiometrically, and their stability constants are reported. The stability sequence with respect to secondary ligands is glycine > alanine > leucine > valine > asparagine > glutamine. (auth)

15054 STRUCTURE AND THERMAL BEHAVIOR OF SCHIFF BASE COMPLEXES OBTAINED FROM ALKANOLAMINES AND SALICYLALDEHYDE. Rao, G. N.; Rustagi, S. C. (Indian Inst. of Tech., Delhi). Indian J. Chem.; 11: No. 11, 1181-1183(Nov 1973).

Complexes of Cd(II), Zn(II), Cu(II), Ni(II), Co(II), VO(II), and UO_2(II) with Schiff bases derived from salicylaldehyde and (a) isopropanolamine (II) and (b) 2-amino-2-methylpropanol (III) were prepared and characterized. Structures of various metal complexes were suggested on the basis of visible and infrared spectra and magnetic moments. Ligands prepared exhibit both bidentate and tridentate character depending on the nature of the metal ion. Thermogravimetric analysis of the complexes show the formation of 1:1 intermediates in many cases and some of these intermediates have been isolated. Formation of dimers in systems involving Cu(II) and VO(II) is indicated. (auth)

15055 CHROMATOGRAPHICAL DETERMINATION OF RADIOCHEMICAL PURITY OF HIPPURAN-^{131}I. Kim, J.; Kim, T. H. J. Korean Nucl. Soc.; 5: No. 3, 234-239(1973).

A recently known method of paper chromatographical separation of 9-iodobenzoic acid-^{131}I and o-iodohippuric acid-^{131}I was found to be in error. The solvent mixture proposed in the method for the efficient separation of the two compounds of similar structure is not only nonhomogeneous but also brings about no separation. No o-iodohippuric acid is converted to o-iodobenzoic acid during the process for Hippuran-^{131}I preparation by isotopic exchange. An alternate method of chromatographical determination of radiochemical purity of Hippuran-^{131}I is proposed. (Korean Sci. Abstr.)

15056 TRANSURANIUM(V) PEROXIDES. Musikas, C. (CEN, Fontenay-aux-Roses, France). J. Chim. Phys.; 71: No. 2, 197-202(Feb 1974). (In French).

Potentiometric and spectrophotometric measurements were made to study the reactions between H_2O_2 and Np(V) in aqueous solution. The solid compounds $(NpO_2)_2OO$, $NpO_2(OO)Na$, $NpO_2(OO)_3Na_5$ could be precipitated from aqueous solutions. Neptunium(V) peroxides are not homologous of Pa(V) or Nb(V) peroxides but are uranyl(VI) like peroxides. They are less stable than the correspondent U(VI) peroxidic complexes. (FR)

15057 QUANTITATIVE STUDY BY ABSORPTION SPECTROPHOTOMETRY OF THE CHEMICAL EQUILIBRIA IN SOLUTION IN FUSED-SALT BATHS. Application to Uranium. Lysy, R.; Landresse, G.; Duyckaerts, G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 10: No. 8, 685-695(Aug 1974). (In French).

An apparatus is described for preparing known mixtures of gases (N_2, H_2O, HCl). A quantitative study was made of the following equilibrium in a fused LiCl–KCl eutectic: $2UO_2^{2+} + 4HCl \rightleftharpoons UO_2^{++} + U^{4+} + 2H_2O + 4Cl^-$. At the same time the equilibrium constants and mean values of $\overline{\Delta H}$ and $\overline{\Delta S}$ were found in the temperature range 450° to 650°C. The equilibrium constant of the reaction, $2HCl + O^= \rightleftharpoons H_2O + 2Cl^-$, was also determined in the same fused salt bath at 450°C. (auth)

15058 NONRADIOACTIVE SILVER. Whitehead, N. E.; Robinson, B. W. (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). Nature (London); 249: No. 5459, 777(21 Jun 1974).

Reference is made to Lindner (Nature 240: 463 (1972)) who reported the detection of small amounts of ^{108m}Ag and ^{110m}Ag in silver bars from an Eastern European source, and made suggestions for the origin of these nuclides. A further possibility was suggested by Boyle (Nature 243: 460 (1973)) in that intimate contact of Ag, U, and light elements such as B might produce, through (α,n) reactions, enough neutrons to give measurable amounts of the above Ag radioisotopes. The present authors checked this speculation by examining a number of specimens of Ag ore associated with U ores. No measurable ^{108m}Ag or ^{110m}Ag was found in the samples. It is considered that the most likely source of the reported activity

was the addition of Ag tracer to the Ag during some stage of the refining process. (UK)

15059 PRODUCTION OF 1-^{11}C ACETOACETIC ACID. Straatmann, M. G.; Hortmann, A. G.; Welch, M. J. (Washington Univ., St. Louis). J. Label. Compounds; 10: No. 1, 175-179(1974).

Interest in labelled compounds, which can be studied as brain metabolites and can be detected in vivo has led to production of carbon-11 labelled acetoacetic acid (1-^{11}C-acetoacetic acid). This synthesis, which was designed specifically for use with short-lived isotopes, utilizes a solution of the stable enolate anion of acetone, generated by the reaction of Ch_3Li and isopropenyl acetate, to which the $^{11}CO_2$ is added to produce the labelled acetoacetic acid in ~55% yield with a synthesis time of only 40 minutes from the end of bombardment. (auth)

15060 PRODUCTION OF HIGH PURITY HALIDES. Baldwin, W. H. (to United States Atomic Energy Commission). US Patent 3,821,356. 28 Jun 1974. Filed date 8 Mar 1973. 4p.

A single-step process for the conversion of lanthanide or actinide oxides by taking advantage of the halogenating and solvent capacity of selected amine hydrohalides is described. The process can be conducted in a single reaction vessel with a minimum of manipulations. (Official Gazette)

Radioactive Waste Treatment

Refer also to abstracts 14836, 15297, 15423, 16489, 16492, and 17632.

15061 (CONF-740406-17) EFFLUENT MONITORING ASSOCIATED WITH FLUIDIZED-BED WASTE CALCINER FACILITY OPERATIONS. Girton R. C.; Pence, D. T. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs - Operations Office). 1974. 13p. Dep. NTIS $4.00.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Monitoring of radioactive effluents from fluidized-bed high-level radioactive waste calcining facilities presents some unique and challenging problems. Effective off-gas treatment systems must be employed because of the large amount of radioactive-containing fines associated with the fluidized-bed operations. Verification of process decontamination efficiencies and effluent inventory measurements are difficult when the particulates behave as gases. The complex chemistry of ruthenium further complicates these tasks. Techniques and procedures used and planned to ensure adequate surveillance of these effluents are described. (auth)

15062 ACID DIGESTION OF COMBUSTIBLE NUCLEAR WASTE: SCALE-UP STUDIES. Lerch, R. E.; Cooley, C. R. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 192-193(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15063 ACCEPTANCE TESTING OF ABSOLUTE PARTICULATE AND ACTIVATED CHARCOAL FILTERS AT THE NATIONAL NUCLEAR RESEARCH CENTER, PELINDABA. Adrian, H. W. W.; Kruger, J.; Page-Shipp, R. J. (Atomic Energy Board, Pelindaba, South Africa). pp 503-522 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

A general discussion is given of the need for and use of particulate filters and gas absorbers at nuclear installations. Experience has shown that it is not necessary to test new units for quality control purposes. However, care must be exercised in the installation of filters and some necessary precautions are described. The routine filter tests are thus designed as checks of the installation (i.e., leak tests). For these purposes, an in-situ testing procedure using Condensation Nucleus counters is employed for particulate (absolute) filters, and a methyl iodide procedure for gas absorbers. The testing procedures and equipment are described. An elemental iodine test for gas absorbers is also described. This test is avoided for routine purposes because of the tendency of elemental iodine to adhere to and contaminate surfaces and of problems arising from conversion of elemental iodine to organic forms. A test rig which is used for research purposes is also described. (auth)

15064 RADIOACTIVE WASTES. Sousselier, Y. (CEA, Chatillon, France). Ann. Mines; No. 1, 77-86(Jan 1974). (In French).

The different sources of radioactive waste are reviewed together with the quantities of such materials that will be produced in the future. The processing of these wastes is discussed. In the processing, the volume of the wastes is reduced before they are stored. The storage must not expose the present population or future generations to any risks. The storage is effected at the surface or inside appropriate geological formations depending on the activity and half-life of the waste considered. The cost of processing and storing radioactive wastes represents less than 1% of the price of the electricity produced by nuclear plants. (FR)

15065 LEACHING OF RADIONUCLIDES FROM SOLIDIFIED WASTES AND ITS MATHEMATICAL ANALYSES. Terasima, Y. (Kanazawa Univ., Japan). Doboku Gakkai Ronbun Hokokushu; No. 209, 51-61(Jan 1973). (In Japanese).

With respect to leaching of radionuclides from the solidified waste which becomes a problem in the appreciation of safety in the disposal of radioactive solidified waste, IAEA standardized the testing methods, but as to the analyzing methods of the result have not been standardized. Therefore, technical terms such as "leaching mass flux" ($g/cm^2 \cdot d$), "leaching activity flux" ($Ci/cm^2 \cdot d$), "activity leaching rate" (total contents/primary contents) and coefficient of leaching velocity (cm/α) were proposed, and the leaching mechanism in each rate control step was explained using said technical terms. First of all, when solution velocity of the surface of solidified waste and the velocity of boundary layer diffusion are in the rate control step, for example, the solidified waste in the form of glass and cement, they can be explained on the basis of the coefficient of leaching velocity, and when the diffusion in solid phase becomes the rate control, namely, such as the solidified waste in the form of glass and asphalt, including the case of occurrence of surface dissolution, a formula of the leaching activity flux and the leaching mass is obtained, and furthermore, a method of obtaining the diffusion coefficient in solid phase, coefficient of adsorption velocity and coefficient of leaching velocity were indicated. Also, regarding porous solidified waste, for example, cement solidified waste, a process of leaching of the radionuclides that makes the diffusion migration of the internal gap with circular pillar as an object, and a formula of means leaching activity flux and leaching rate was obtained. (JA)

15066 METHOD AND DEVICE FOR THE REMOVAL OF MEDIUM- TO HIGH-ACTIVITY SOLID WASTES WHICH ARE PRODUCED IN SMALL AMOUNTS. Boden, H.; Herter, R. (to Werner und Pfleiderer Maschinenfabrik). German(FRG) Patent 2,240,119. 3 Jan 1974. 4p. (In German).

The patent claim refers to a procedure for the immediate processing of produced medium- to high-level solid waste which is mixed up with water, particularly filter materials. Most of the water is removed by using special mechanical transport equipment, the rest of the water by means of evaporation during the transport. A dosage device allows a uniform injection into bitumen which acts as the solidification material. Thus, the particular safety regulations with respect to activity concentration can be met. (GE)

15067 DEVELOPMENT AND CURRENT TECHNICAL STATUS OF DECONTAMINATION EVAPORATORS. Mende, H. (Luwa-SMS Anlagen und Apparate fuer die Chemische und Verwandte Industrie G.m.b.H., Butzbach (F. R. Germany)). Kerntechnik; 16: No. 4, 170-177(Apr 1974). (In English, German).

11 figs.; 6 refs.

The decontamination factor of evaporators depends on the quantity and concentration of the droplets entrained into the distillate from the concentrated residual liquid in the evaporator. The effectiveness of various droplet separators is discussed with the help of examples. The effective decontamination factor (EDF) of double distillation evaporators is limited by design factors. Substantially higher EDF values can be achieved with singlestage evaporators followed by a vapor scrubbing column. (GE)

15068 FLOTATION ISOLATION OF ^{106}Ru FROM AQUEOUS SOLUTIONS. Evtyukhova, O. E.; Nikiforov, A. F.; Berezyuk, V. G.; Pushkarev, V. V. Sov. Radiochem. (Engl. Transl.); 15: No. 4, 637-640(1973).

Translated from Radiokhimiya; 15: No. 4, 631-634(1973).

A study was made of the extraction of microamounts of ^{106}Ru, present in solution in the form of nitroso compounds, by ionic flotation using quaternary ammonium salts as collectors. Addition of the oxidants H_2O_2 and $KMnO_4$ to the solution increases the entrainment of ruthenium into the foam to 80 to 99%. The maximum extraction of the radioisotope under the optimal conditions occurs in the pH range of 6.0 to 9.0. On the basis of the experiments carried out the hypothesis was put forward that under the conditions studied the ruthenium is floated in the form of electrically neutral colloidal particles. (auth)

15069 REMOVAL OF Kr-85 DISSOLVED IN SOLUTION. I. Methods and Effects of Removal. Ootsuka, N.; Yamamoto, T. (Japan Atomic Energy Research Inst., Takasaki). Nippon Genshiryoku Gakkaishi; 16: No. 2, 98-104(Feb 1974). (In Japanese).

When unsealed ^{85}Kr β-irradiation facilities are used for chemical reactions in the liquid phase, the ^{85}Kr gas must be removed from the reaction system after irradiation, and the radioactive concentration reduced to a level below $(MPC)_w$. Removal experiments were carried out with water and with an aqueous solution of polyacrylamide using a reaction vessel of 1l capacity containing a ^{85}Kr radiation source of 290 Ci. The methods of removal and the results obtained therewith are discussed. The removal is accomplished by the combined use of freeze-pump-thaw cycles, N_2-stripping and standing at room temperature. The overall decontamination factor reaches 10^8. (auth)

Radioisotope Production

Refer also to abstracts 15741, 16102, 16662, and 16672.

15070 (JAERI-M-5413) PROGRESS REPORT OF THE RADIOISOTOPE PRODUCTION FOR FISCAL 1971. (Japan Atomic Energy Research Inst., Tokyo). 1973. 67p. (In Japanese). INIS.

Research and technical developments in the production of radioisotopes in the Division of Radioisotope Production, Radioisotope Center, for the fiscal year 1971 are described. The study of hot-atom effect to be utilized in radioisotope production and the development of the processing for short-lived radioisotopes from fission products and for ^{14}C and ^{131}I were completed. These works, continued for several years in the past, provide useful information for the actual production. Many advances were also achieved in other areas. For example, systematic isolation of long-lived radioisotopes from the fission products by ion-exchange was successful, and the trial production cell for separation of radioisotopes from the fission product by solvent extraction was designed and constructed. Research on the computer analysis of γ spectra applicable in many fields further proceeded. Effects of the analysis will be increased by completion of an on-line data acquiring system on the future. (auth)

15071 CURIUM-244 RECOVERY FROM SPENT REACTOR FUEL. Carney, H. C. (General Atomic Co., San Diego, CA); Shefcik, J. J. Jr.; van Tuyl, H. H. Trans. Amer. Nucl. Soc.; 18: 13(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15072 FLOWSHEET FOR RECOVERY OF CURIUM FROM POWER REACTOR FUEL REPROCESSING PLANT WASTE. Wheelwright, E. J.; Bray, L. A.; van Tuyl, H. H. (Battelle Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 13-14(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15073 PLUTONIUM-238 PRODUCTION IN POWER REACTORS. Roach, K. E. (Southern Nuclear Engineering, Inc., Dunnedin, FL). Trans. Amer. Nucl. Soc.; 18: 15(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15074 METHOD OF QUICK EXTRACTION OF SHORT HALF-LIFE ISOTOPES OF Os AND DAUGHTER ISOTOPES OF Re. Vaishnis, P. P.; Ignatenko, E. I.; Konev, V. G.; Sergeev, Yu. Ya. (Leningrad Inst. of Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 126(Jan 1973). (In Russian).

A method for the rapid separation of the short-lived isotopes of Os obtained during the irradiation of mercury nitrate with 1-GeV protons was described. The total time for the preparation of the Os source is 10 to 15 sec. (tr-auth)

15075 SEPARATION OF TRANSPLUTONIUM ELEMENTS FROM NEUTRON-IRRADIATED AMERICIUM-241. Ueno, K.; Watanabe, K.; Sagawa, C.; Ishimori, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 11: No. 1, 8-14(Jan 1973).

The isotopes of transplutonium elements were produced by irradiation of 10.5 mg of $^{241}AmO_2$ in the Japan Materials Testing Reactor during the period May 1970 through June 1971. Transplutonium elements were separated from plutonium, fission products, and cladding materials by a combination of precipitation and ion exchange methods. Americium, curium, and californium were mutually isolated by ordinary procedure. Plutonium-238-242, americium-241-243, and curium-242-245 were detected in the plutonium, americium, and curium fractions, respectively. The ratios of the amounts present of these isotopes were determined by mass spectrometry. It was not possible to identify ^{249}Bk in the berkelium fraction owing to the interference from other β-ray emitting nuclides. In the californium fraction, both spontaneous fission and α-activities due to $^{250,252}Cf$ were observed. (auth)

15076 SEPARATION OF URANIUM-234 FROM AGED PLUTONIUM-238. Russell, E. R. (Savannah River Lab., Aiken, SC). J. Inorg. Nucl. Chem.; 36: No. 7, 1659-1660(Jul 1974).

Small quantities of highly purified ^{234}U can be readily separated from aged ^{238}Pu by precipitating the uranium as $NaUO_2(Ac)_3$. Two precipitations of uranium yielded a product containing less than 10 ppM ^{238}Pu contamination. (auth)

15077 MICROCHEMICAL PREPARATIONS OF METALLIC CURIUM-248 AND CALIFORNIUM-249 BY THE REDUCTION OF THEIR TRIFLUORIDES, AND RELATED STRUCTURAL STUDIES. Stevenson, J. N. Knoxville, TN; Univ. of Tennessee (1973). 107p. University Microfilms Order No. 74-11,292.

Thesis (Ph. D.).

Samples of the trifluorides of californium-249, curium-248 and curium-244 were prepared. The high temperature, trigonal modification of CfF_3 was prepared by quenching methods and the phase transitions were studied. The average, room-temperature lattice parameters determined for the trigonal structure are: a_0 = 6.945(3)Å; c_0 = 7.101(2)Å. Previously unreported values for orthorhombic CfF_3 were averaged with reported values to obtain room-temperature lattice parameters of: a_0 = 6.653(3)Å; b_0 = 7.039(1)Å; c_0 = 4.393(2)Å. The transition temperature was estimated to be between 550 and 700°C. The average, room-temperature lattice parameters for $^{248}CmF_3$ are: a_0 = 7.014(3)Å; c_0 = 7.194(3)Å; and for $^{244}CmF_3$, they are: a_0 = 7.019(18)Å; c_0 = 7.198(20)Å. The average parameters determined from the radiation-damaged $^{244}CmF_3$ samples were not significantly different from those of $^{248}CmF_3$. The accuracy of the lattice parameters determined for $^{244}CmF_3$ does not justify a definitive statement on the presence or absence of radiation-induced expansion of the $^{244}CmF_3$ lattice. Experimental apparatus and methods were developed for the microchemical preparations of metallic curium-248, berkelium-249, and californium-249 by the reduction of their trifluorides at elevated temperatures. The same apparatus and methods were used to prepare metal samples ranging in size from below 10 μg up to 500 μg and with volatilities covering several orders of magnitude. Curium-248 metal was found to exhibit the face-centered cubic (fcc) and double hexagonal closest-packed (dhcp) phases analogous to those of curium-244 metal. Average, room-temperature lattice parameters for the dhcp phase of curium-248 metal are: a_0 = 3.500(3)Å; c_0 = 11.34(1)Å; and for the fcc phase: a_0 = 5.070(8)Å. For the first time the complete reversibility of the transformation between the phases has been demonstrated, thus supporting the conclusion that the fcc phase is a true, high-temperature form of curium metal. Californium-249 metal was found to exhibit a fcc structure with an average, room-temperature lattice parameter a_0 = 4.994(12)Å. The possibility of the existence of other phases was indicated by the presence of additional lines in one pattern. The nitrides of curium-248 and berkelium-249 were prepared by reaction of the metals and/or their hydrides with nitrogen. Curium-248 nitride was found to exhibit a fcc structure with an average, room-temperature lattice parameter a_0 = 5.027(12)Å. One sample of berkelium nitride yielded the fcc parameter a_0 = 5.010(4)Å. The reported error limits on average values of lattice parameters represent the 95% confidence level calculated by using the standard statistical method for the average of independent determinations. The error limits (2σ) reported for the lattice parameter of BkN indicates only the internal consistency of that set of data. (Diss. Abstr. Int., B)

15078 ^{68}Ge-^{68}Ga GENERATOR FOR THE PRODUCTION OF ^{68}Ga IN AN IONIC FORM. Kopecky, P.; Mudrova, B. (Nuclear Research Inst., Rez, Czech.). Int. J. Appl. Radiat. Isotop.; 25: No. 6, 263-268(Jun 1974).

Some aspects of the adsorption of carrier-free ^{68}Ge and ^{68}Ga on alumina, $Al(OH)_3$ and $Fe(OH)_3$ have been investigated. The results of static adsorption experiments and their application on column conditions are presented. This makes possible the preparation of a ^{68}Ge-^{68}Ga adsorption generator, from which ^{68}Ga can be eluted directly in an ionic form. (auth)

15079 PRODUCTION OF CARRIER-FREE INDIUM-111. Levin, V. I.; Kozlova, M. D.; Malinin, A. B.; Sevastianova, A. S.; Potapova, Z. M. (Inst. Biofiziki, Moscow). Int. J. Appl. Radiat. Isotop.; 25: No. 6, 286-288(Jun 1974).

A method is described for the separation of ^{111}In in high nuclidic and chemical purity from silver and cadmium targets which is used

in the USSR for routine production of ^{111}In for medical use. The method is based on solvent extraction of indium by di(2-ethylhexyl)-phosphoric acid (D2EHPA) and butyl acetate successively. (UK)

15080 USE OF ALUMINA AS AN ION EXCHANGER IN THE SEPARATION OF CARRIER-FREE RaE FROM RaD. Bhattacharyya, D. K. (Saha Inst. of Nuclear Physics, Calcutta). Separ. Sci.; 9: No. 3, 257-260(1974).

A very simple procedure for the radiochemical separation of carrier-free RaE (^{210}Bi) from RaD (^{210}Pb) was developed. RaE as sulfate was adsorbed in powdered alumina column, which was later quantitatively washed out with hot conc. HNO_3. The radiochemical purity of RaE was proved by studying the β-decay half-life of the isotope. (auth)

15081 DEVELOPMENT AND EVALUATION OF A ^{103}Pd–^{103m}Rh RADIONUCLIDE GENERATOR. Berk, H. W. Lafayette, IN; Purdue University (1971). 107p. University Microfilms Order No. 74-8930.

Thesis (Ph. D.).

A radionuclide generator for producing carrier-free, radiochemically pure ^{103m}Rh suitable for medical use was developed using the technique for ion-exchange. Carrier-free ^{103}Pd in the form of palladous chloride was loaded on an ion-exchange resin and the ^{103m}Rh daughter eluted, as needed, by passing physiological saline solution through the column. No radiochemical contaminants were detected in the ^{103m}Rh eluate. The generator can be packaged in a form that allows elutions of sterile, pyrogen-free ^{103m}Rh for injection. Approximately 40% of the ^{103m}Rh present on the column can be removed with each elution by this method. Consequently, ^{103m}Rh could be eluted from the column 3 times a day with as much as 1 mCi of ^{103m}Rh obtained 34 days after preparation of a column containing an initial load of 10 mCi of ^{103}Pd. A scanning study involving a kidney phantom, an adult rat and two adult beagle dogs showed that the low energy x-ray emission from an equilibrium solution of ^{103}Pd–^{103m}Rh could be satisfactorily detected utilizing a rectilinear scanner equipped with a 1 × 3-inch NaI(Tl) crystal and a 3-inch coarse focus, 55-hole low energy collimator. A whole body scan of an adult beagle dog that received an intravenous injection of 1.5 mCi of ^{103m}Rh in the chemical form in which it was eluted from the ion-exchange column showed localization of the ^{103m}Rh in the bladder. Efforts to create ^{103m}Rh colloids or chelates that would have the capacity to localize in certain organs, particularly the kidneys and liver, were unsuccessful. Rhodium trichloride administered intravenously to rats and rabbits was found to be a substance of low toxicity. The thirty day LD_{50} for rhodium trichloride administered by a single intravenous injection to the male Sprague–Dawley strain rat was 198 ± 14 mg/kg and to the male white albino rabbit was 215 ± 77 mg/kg. Histological examination of the kidneys, lungs, liver, heart, and spleen of rats and rabbits sacrificed 100 days, and 30 days respectively after receiving various doses of rhodium trichloride revealed no pathological changes. No pathology was observed upon microscopic examination of the major organs of rats and rabbits who had died from lethal doses of rhodium trichloride. (Diss. Abstr. Int., B)

Reactor Fuel Reprocessing

Refer also to abstracts 15269, 15542, 15563, 15646, 15699, and 17500.

15082 (CONF-740314-2) DETERMINATION OF ACIDITY OF COMPLEX SOLUTIONS USING AN N-SILICON/STAINLESS STEEL ELECTRODE. Reeder, S. D.; Kendall, D. R.; Yamamura, S. S. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). 1974. 27p. Dep. NTIS $4.50.

From 25th Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio, USA (4 Mar 1974).

The determination of acidity in solutions in spent fuel reprocessing or radioactive waste processing is considered. For example, Al, stainless steel, and zirconium-clad uranium bearing fuels are processed and some of the resulting process streams that require acidity measurements are considered. An acid meter used in the study has a HCl-sensitive n-silicon–stainless steel combination cell. The effects of fluoride complexing and hydrolyzable metal ions on an acid determination in an ammonium fluoride electrolyte are discussed. (MCG)

15083 (CONF-740406-18) NO_x ABATEMENT AT NUCLEAR PROCESSING PLANTS. Pence, D. T.; Thomas, T. R. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). 1974. Contract AT(10-1)-1375. 17p. Dep. NTIS $4.00.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Results of a laboratory investigation to determine the applicability of a process using a zeolite-catalyzed ammonia reaction for NO_x abatement in nuclear processing plant effluents are reported. The test results show greater than 99% efficiencies for conversion of NO_x to innocuous gases are obtainable over a wide range of operating conditions, even in the presence of air and high humidities. The process design criteria appear to be compatible with normal off-gas treatment process requirements. (auth)

15084 (DOCKET-50332-38) BARNWELL NUCLEAR FUEL PLANT. License Application, PSAR, Addendum 7 Revision, July 1974. Plutonium Product Facility. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). 1 Jul 1974. 935p. Dep. NTIS $49.75.

The Plutonium Product Facility will be added to the plant to convert liquid plutonium nitrate to solid plutonium oxide by plutonium oxalate precipitation and calcination and to provide storage of plutonium oxide. An additional Emergency Utility Area (EUA) Building will be provided. Sections of the report include: description, safety analyses, site characteristics, design criteria, process systems, auxiliary systems, utility systems, facility design, radiological protection, waste management, engineered safety features, instrumentation and control, conduct of operations, preoperational testing, accident analyses, technical specifications, and quality assurance. (MCG)

15085 (DOCKET-50332-39) BARNWELL NUCLEAR FUEL PLANT. License Application, PSAR, Addendum 7 Revision, July 1974. Plutonium Product Facility Appendices. (Allied-General Nuclear Services, Barnwell, S. C. (USA)). 1 Jul 1974. 208p. Dep. NTIS $13.50.

Reports of subsurface investigations and foundation design studies for the Plutonium Product Facility are presented. Subsurface conditions, settlement characteristics, and effects of berm construction of the facilities are discussed. (MCG)

15086 NEW INTEGRATION OF THE GIBBS–DUHEM EQUATION AND APPLICATION OF PHASE RELATIONS AND THERMODYNAMICS TO FUEL REPROCESSING. Chiotti, P. (Ames Lab., IA). J. Nucl. Mater.; 51: No. 1, 178-194(May 1974).

The application of phase relations and thermodynamic properties to the design of fused salt and liquid metal processes for the separation of fission product elements from nuclear fuel materials is described. Processes can be designed to extract minor components from a fuel material without drastically altering its character or state of aggregation. It is possible to effectively transport solutes from one liquid metal or alloy to a second liquid metal or alloy by bringing the two in contact with an appropriate fused salt. Alternatively it is possible to transport solutes between two liquid salt phases by bringing them in mutual contact with an appropriate alloy. A process for extracting uranium from a thoria–urania solid solution powder by reactions in a fused salt medium is described. The value of the activity coefficient of any particular solute at infinite dilution is an important parameter in determining the ultimate degree of separation to be expected in a given process. Interpolation functions for evaluating the properties of dilute solutions are examined and a new integration of the Gibbs–Duhem equation for binary alloys is developed. The method described lends considerable versatility to the types of curves or functions which can be integrated to yield data for a second component in a binary solution. (auth)

15087 NUCLEAR FUEL AND MASS SPECTROMETRY. Sato, H. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). FAPIG (Tokyo); No. 67, 144-149(Nov 1972). (In Japanese).

The roles of mass spectrometry in each field of the fuel cycle are reviewed. As the introduction, growing total atomic power output in Japan is explained. It is expected that in 1985, the total output will be about 60,000 MWe, which will annually require about 6,000 MT SWU of enriched uranium. Brief review is given to show necessity and problems of the mass spectrometry in the fields of mining, refinement, conversion, enrichment, fuel fabrication, reactor operation and reprocessing. Emphasis is placed on the enrichment, reprocessing and fabrication, in which the mass spectrometer is indispensable. In the second part, some technical aspects of the mass spectrometry are discussed. The objective isotopes to be analyzed are uranium, plutonium, fission products and transuranium elements. Three different methods of the mass spectrometry (electron bombardment, surface ionization and isotopic dilution) are explained, and compared with each other. Use of computers for automated analysis and NBS standard isotopic samples of uranium and plutonium are also shortly referred. Finally, increasing importance of the mass spectrometry in the field of international management of fissile material is emphasized. (JA)

15088 UNEXPECTED MELTDOWN OF SCRAP URANIUM–ALUMINUM CERMET CORES DURING OUTGASSING. Gray, L. W. (E. I. du Pont de Nemours and Co., Savannah River, SC). Nucl. Safety; 15: No. 4, 455-460(1974).

During routine outgassing of scrap uranium–aluminum cermet cores, unexpected exothermic reactions released sufficient energy to melt nine cores. In the subsequent investigation, compounds in the scrap uranium were identified, and the history of the material was defined. The incident was initiated by reactions at ~350°C between powdered aluminum metal and mixed uranate salts, which released sufficient energy to initiate other aluminothermic reactions. A plausible reaction sequence is postulated to account for the energy released in the incident. (auth)

15089 EXPERIMENTAL STUDY OF FLUORIDE VOLATILITY PROCESS FOR THORIUM FUELS. Shimada, S.; Okumura, I.; Higashi, K. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 11, 689-695(Nov 1973).

Selective removal of uranium from $(Th/U)O_2$ by fluorination with fluorine was studied experimentally. The fluorination was performed both in a small boat and in a 2-inch inner diameter fluid-bed reactor. Fuel particles tend to agglomerate in the reactor due to the large amount of reaction heat and the comparatively low melting point of ThF_4. The fluorinated fuels produced in the fluid-bed reactor were found to be partially agglomerated. Fractional retention of uranium was smaller in the agglomerated parts than in the un-agglomerated, and smaller in the outer layers of the cakes than in the core. On the other hand, it was also established beyond doubt from the results of the small boat fluorination experiment that heavy agglomeration inhibits the volatilization of uranium in the form of UF_6. Inhibition of the violet exothermic reaction by lowering the fluorine pressure in the early stage of fluorination was found to be a very effective method of obtaining high uranium recovery. It was demonstrated that more than 99% of the uranium could be volatilized within 4 to 5 hr at a temperature of 580°C. The experimental results on the effects of temperature, particle size and fluorine concentrations are presented. The variations of reaction rate observed in the course of fluorination are also discussed. (auth)

15090 SPENT FUEL FOR THE CZECHOSLOVAK NUCLEAR POWER SYSTEM. Vesely, V. Jad. Energ.; 20: No. 3, 73-77 (Mar 1974). (In Czech).

The reprocessing of spent fuel economically is advantageous because it makes it possible to reduce the cost of electrical energy. For power systems based on water-water reactors, industrial installations with a capacity of 2 t/day are profitable in the reprocessing of spent fuels. The uranium isotopic mixture obtained from the regeneration is sufficient to cover the processing costs. This makes the Pu obtained practically free which should stimulate the development of fast reactors. If in Czechoslovakia there is no need for reprocessing plants for spent fuels from thermal reactors, the need for reprocessing installations for fast breeder systems is evident. (tr-auth)

15091 CLARIFICATION OF SOLUTIONS PRIOR TO EXTRACTIVE REPROCESSING OF WATER-MODERATED WATER-COOLED POWER REACTOR FUEL ELEMENTS. Rozen, A. M.; Mal'tsev, I. M.; Simakov, D. V. At. Energ. (USSR); 36: No. 6, 502-506(Jun 1974). (In Russian).

A study has been made of the filtration of water-moderated water-cooled power reactor fuel-element solutions using cartridge filters. The solutions have been shown to be filtered with difficulty due to high dispersity of sediment (primarily graphite particles up to 6 microns in size). Acceptable average clarification rates (about 500 $l/m^2 \cdot hr$ for a specific capacity of ~5 m^3/m^2) are attained by treating the solution jointly with a flocculating agent (gelatine) and a subsidiary filtering substance (perlite). It is advisable to use classified perlite. In view of the high compressibility of the sediment the rate of filtration is weakly dependent on pressure. A pressure of 3 kg/cm^2 is sufficient. The specific resistance of the sediment has been determined and a physical model of the process which permits to describe filtration acceleration as induced by the subsidiary filtering substance has been developed. Experiments using solutions of irradiated fuel elements show that irradiation practically does not change the filtering behavior of solutions. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

15092 PLASMA PHYSICS INDEX. Volume 9, No. 5, 1974. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 146p.

15093 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 5, 1974. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle Fuer Atomkernenergie-Dokumentation (1974). 44p.

Confinement and Heating

Refer also to abstracts 15160 and 15248.

15094 (AREAEE-175) TURBULENT HEATING OF IONS BY A COLLISIONLESS SHOCK. Demchenko, V. V.; Hussein, A. M. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 44p. Dep. NTIS (US Sales Only) $5.25.

Ion turbulent heating in a collisionless shock wave (CSW) propagating in a plasma across the magnetic field was investigated. The ion heating is demonstrated to be determined by nonlinear interaction of ions with turbulent oscillations appearing at the shock front due to the current-driven instability. The heating process occurs in two states: (a) "preheating" of ions from $T_{i0} \approx T_{e0}$ up to $T_i \gg T_e$ owing to hydrodynamic current instability (HCI) and (b) transformation of HCI into kinetic electron-sound instability (ESI) leading to a subsequent effective heating of ions. The ions exposed to HCI are heated by a stochastic mechanism, while at ESI the ion temperature increases due to absorption of unstable oscillation energy by ions under conditions of Cherenkov resonance (quasilinear heating mechanism). The equations that describe the ion temperature variation at the CSW front were obtained and the heating time both under HCI and ESI is estimated. The estimates obtained agree well with the known experimental data. (auth)

15095 (IPPJ-171) METHOD TO MAKE THE rf PLUGGING EFFICIENT IN THE POINT CUSP. Hatori, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1973. 14p. INIS.

It is possible to make the width (radius) of the plasma in the line (point) cusp to the order of the ion thermal Larmor radius, when the plasma is injected from one of the point cusps. To do this, it is indispensable to prevent electrons from flowing back through the line cusp. The thin (slender) plasma is convenient for the rf plugging method. It may be possible to improve greatly the containment of the axially symmetric system, by utilizing the cusp geometry together with the rf plugging method. (auth)

15096 (IPPJ-174) THEORETICAL PREDICTION OF THE OBSERVED PLASMA HEATING IN THE COMPRESSION EXPERIMENT OF ITO'S GROUP AT OSAKA UNIVERSITY. Alexeff, I. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1973. 8p. INIS.

A simple, model-independent description of the compression experiment of Itô's group at Osaka University predicts the observed plasma heating and final plasma β to within a factor of two. (auth)

15097 (N-71-32159) ONE-DIMENSIONAL LASER HEATING OF A STATIONARY PLASMA. Steinhauer, L. C.; Ahlstrom, H. G. (Washington Univ., Seattle (USA)). Aug 1971. 39p. (NASA-CR-1854). NTIS.

The problem of laser energy addition to a nonuniform one-dimensional plasma is considered. The object is to study plasmas which may achieve temperatures and densities of interest for application to controlled thermonuclear reactions (CTR). The advent of the nanosecond and picosecond lasers makes it possible to consider the heating of stationary, non-thermally conducting plasmas with a nonuniform density distribution in which only the electrons are heated. The solutions show that for a wide range of relevant parameters these assumptions are valid. The temperatures that can be produced are of interest in CTR. Depending on the steepness of the density gradient, either wave-like or simultaneous heating is produced. Also, the temperature distribution is very much nonuniform and can significantly affect the subsequent dynamics of the plasma. (auth)

15098 (UCID-15745) SURVEY OF THE PHYSICS OF PLASMA HEATING BY LASER LIGHT. Shearer, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Dec 1970. 36p. Dep. NTIS $5.00.

Starting from Maxwell's equations and the electromagnetic forces exerted on electrons, elementary derivations of electron motion, plasma refractive index and absorption coefficient are presented for laser light absorption by a plasma. A physical picture of the state of the plasma is given. The results of detailed calculations of collisional absorption and electromagnetic pressure effects are presented. Additional effects are discussed, including oblique incidence, electron thermal conductivity, and plasma instabilities. It is concluded that additional research is needed to determine the laser light reflection and absorption coefficients for a wide variety of possible intensities and plasmas. (auth)

15099 PERPENDICULAR ION CYCLOTRON RESONANCE IN A TWO-ION PLASMA. Toyama, H.; Matsuura, K. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 1, 277-280(Jul 1973).

The rf power absorbed at the perpendicular ion cyclotron resonance of an H–D plasma was calculated using the model of an infinitely long coil, with electron density, ion temperature, and the H–D concentration ratio as the parameters. (auth)

15100 PLASMA HEATING NEAR THE LOWER HYBRID RESONANCE. Terumichi, Y.; Kitagawa, Y. (Kyoto Univ.). J. Phys. Soc. Jap.; 35: No. 4, 1273(Oct 1973).

15101 INTERACTION BETWEEN AN INTENSE RELATIVISTIC ELECTRON BEAM AND A PLASMA IN A MAGNETIC FIELD. Abrashitov, Yu. I.; Koidan, V. S.; Konyukhov, V. V.; Laginov, V. M.; Luk'yanov, V. N.; Mekler, K. I.; Ryutov, D. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 66: No. 4, 1324-1337(Apr 1974). (In Russian).

Results are presented of experiments on the interaction between an intense relativistic electron beam (electron energy 1 MeV, current 5 kA, duration 70 nsec) and a plasma (density up to 3×10^{14} cm^{-3}) located in a magnetic field up to 15 kOe. Movement of the beam in vacuum as well as in the plasma is investigated. An appreciable axially-nonsymmetric smearing out of the beam is observed on traversal of a plasma with a density $n < 10^{13}$ cm^{-3}. Possible causes of the phenomenon are discussed. Up to densities of the order of $n \sim 2 \times 10^{14}$ cm^{-3} collisionless heating of the plasma by a relativistic electron beam with an efficiency of 10 to 15% is observed. It is demonstrated that at least at plasma concentrations $n \gtrsim 5 \times 10^{13}$ cm^{-3} the plasma heating may be ascribed to development of beam instability for Langmuir oscillations. Compensation of the beam current by the return current is investigated for various densities of plasma. (auth)

15102 ELECTRON HEATING MECHANISM IN MAGNETIC TRAPS DURING HELICAL ELECTRON BEAM–PLASMA INTERACTIONS. Akshanov, B. S. At. Energ. (USSR); 36: No. 4, 261-268(Apr 1974). (In Russian).

Experimental results of investigating the mechanism of electron beam–plasma heating in magnetic mirror traps during interaction of an intense helical electron beam with plasma are presented. Two regimes have been studied experimentally: $\omega_{Ci} > \omega_{Be}$ and $\omega_{Ci} < \omega_{Be}$ (ω_{Ci} is the electron-plasma frequency, ω_{Be} is the cyclotron frequency) for operation of the magnetic trap in a continuous as well as pulse regime. The heating mechanism has been investigated under highly turbulent plasma conditions, when plasma parameters reached the following values: electron temperature $T_e \sim 100$ keV, hot electron density $n_e \sim 10^{11}$ to 3×10^{11} cm^{-3}, overall density $n \sim 10^{12}$ to 10^{13} cm^{-3} and plasma lifetime $\tau \sim 0.1$ s. Based on the investigation results, one can draw the conclusion that in the magnetic trap there occurs heating of beam as well as plasma electrons. Different types of oscillations are responsible for the electron heating in the two regimes: in the first regime—helical-type oscillations (or oscillations approaching their frequency), in the second regime—oscillations approximating the electron-cyclotron frequency and which vary stochastically. The observed complexity and variety of the different processes accompanying highly turbulent heating are in close agreement with nonlinear theory of turbulent plasma heating. (auth)

15103 HEATING OF ELECTRONS BY LASER PULSES. Ternov, I. M.; Khalilov, V. R. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 2, 195-198(1974). (In Russian).

The change of the average energy of electrons during scattering of powerful electromagnetic waves on them was studied. The expression for the rate of change of the average electron energy was found. (tr-auth)

15104 CONFINEMENT STABILITY OF A CHARGED PARTICLE TRAPPED BY A PLANE ELECTROMAGNETIC WAVE WITH A SLOWLY VARYING PROPAGATION VELOCITY. Davydovskaya, N. A.; Davydovskii, V. Ya.; Ukolov, A. S. (Taganrog

Radio Engineering Inst., USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 722-724(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1132-1136(Jun 1973).

An expression is derived for the variation of the longitudinal adiabatic invariant of a charged particle trapped by a plane transverse circularly polarized quasimonochromatic homogeneous electromagnetic wave whose phase velocity varies slowly in the direction of propagation within the period of particle motion. The first nonvanishing term in this expression turns out to be a third-order term with respect to the small parameter. It is shown in this approximation that in the limit as the wave velocity approaches the velocity of light in vacuum the particle has an equilibrium state that is stable when the wave accelerates and is unstable otherwise. (auth)

15105 LOWER HYBRID RESONANCE HEATING IN A HOT ELECTRON PLASMA. Raimbault, P. A. Madison, WI; University of Wisconsin (1973). 189p. University Microfilms Order No. 74-3547.

Thesis (Ph. D.)

Plasma heating at the lower hybrid resonance was studied both theoretically and experimentally. Several theories were found to explain heating at this frequency. They are: (a) collisional absorption, (b) linear mode conversion, and (c) nonlinear parametric effects. An electron cyclotron resonance mirror confined plasma was observed to absorb an incident lower hybrid resonant wave by the process of linear mode conversion. The rf power was found to transfer primarily to the electrons, but under certain circumstances, i.e., when the electron absorption was decreased, to the ions as well. A decrease in rf absorption by the electrons was obtained by increasing the electron energy perpendicular to a dc magnetic field. This resulted in a decrease in electron Landau damping along the field lines. Since the electron Larmor radius became large with the increase in energy, the electrons can now get out of phase with the wave. It was also found that the electron absorption characteristics are very similar to those for lower off resonance heating. Electron Landau damping along the field lines can account for this effect as well. (Diss. Abstr. Int., B)

15106 HEATING BY CATALYTIC RESISTIVITY OF HIGH TEMPERATURE PLASMAS. Coppi, B. (Massachusetts Inst. of Tech., Cambridge). Lett. Nuovo Cim.; 10: No. 4, 156-160(25 May 1974).

One possibility for plasma heating is to excite plasma fluctuations which produce a resistivity larger than classical by an external microwave source with such a frequency as to couple with and produce the needed amplitudes of the relevant type of plasma modes. In this case the energy source is the magnetic transformer, while the microwave source performs a catalytic function in raising the value of resistivity. An analysis is presented for high-temperature regimes and low-beta plasmas. (MOW)

Diagnostics

15107 (IPP-3/10) DIFFRACTION IMAGE OF A FINITE SIZE OBJECT IN AN ANNULAR APERTURE SYSTEM. Sesnic, S.; Fujita, J.; Pohl, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Jul 1973. 49p. INIS.

The intensity and phase distributions near the geometrical focus of an error-free pencil of monochromatic light bounded by an annular aperture were obtained. The numerical results for a single point scatterer (point source) and for a cylindrical, homogeneous collection of stationary scatterers are discussed. If the central obstruction is kept small, an increase in the size of the scattering volume results in an increase in the size of the central image, across which the intensity and the phase are fairly constant. For medium and large central obstructions the numerical results indicate a very small or no change in the central image size if the scattering volume is increased. This might cause rather severe alignment restrictions if one wanted to use extreme forward laser scattering combined with wave mixing to study tokamak-like plasmas. (INIS)

15108 (IPPJ-172) OBSERVATION OF ION ACOUSTIC WAVE BY MICROWAVE SCATTERING METHOD. Mase, A.; Yamamoto, T.; Tsukishima, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1973. 17p. INIS.

An ion acoustic wave in a current-carrying plasma was studied by a microwave scattering method. A technique of incoherent scattering of electromagnetic wave of f_i = 35 GHz by ion acoustic waves of f = 20 to 70 kHz is described. A dispersion relation and the intensity distribution in k-space of the ion acoustic wave was determined from the angular distribution of the scattered wave. A spatial evolution of the ion acoustic waves along the tube axis was also observed. The observed spatial growth rates are compared with calculated values which take account of both linear and nonlinear growth rates. A good agreement is obtained when the nonlinear effect is assumed as mainly due to the ion-trapping. (auth)

15109 MICROWAVE DIAGNOSTICS FOR THE MEASUREMENT OF PLASMA DENSITY IN A CYLINDRICAL METAL VESSEL. Kuwahara, C.; Hosokawa, M.; Aihara, S.; Ikegami, H. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 13: No. 2, 306-317 (Feb 1974).

The microwave interference method for the measurement of the electron density of plasmas contained in a metal cylinder was studied theoretically and experimentally. It is pointed out that the interferometer signal through the metal vessel can not eliminate the cavity mode effect, even if the dimension of the vessel is large compared with the wavelength of the probing microwave. It is concluded that the cavity mode effect can be ignored, if the Q-value of the cavity filled with plasma satisfies the condition $Q < 2b/\lambda$, where b and λ are the radius of the cylindrical cavity and wavelength of the probing microwave respectively. (auth)

15110 SCATTERING DIAGNOSTICS OF PLASMA BY CO_2 LASER. Nakatsuka, M. (Osaka Univ.); Yokoyama, M.; Yamanaka, C.; Izawa, Y.; Toyoda, K. Denki Gakkai Ronbunshi, A; 93: No. 3, 91-98(Mar 1973). (In Japanese).

The scattering and interference diagnosis of Tp-D stationary plasma was studied using CO_2 lasers. The CO_2 laser was produced by low pressure axial discharge. Maximum power was about 30 W, and laser efficiency was about 5%. The TPD-I plasma machine of the Plasma Institute, Nagoya University was used. The diagnosis was performed at the plasma region where pressure was 2.8×10^{-3} torr, and magnetic field intensity was 1.2 kG. The detector was a Ge:Cu infrared detector with a cooled interference filter. Electron density was measured by interferometry to check the result of scattering diagnostics. Ion temperature, electron temperature, and electron density can be measured by using the laser. Wavelength of the CO_2 gas laser is longer than that of the ruby laser, and measurement of the ion temperature with the CO_2 gas laser is easier than with the ruby laser. The absolute electron density was successfully obtained by using Rayleigh scattering. Large refraction was seen. The results were in good agreement with those from interferometry. The electron density increased nonlinearly with discharge current. (JA)

15111 MEASUREMENT OF LONG-WAVELENGTH TURBULENCE WITHIN A COLLISIONLESS SHOCK BY SCATTERING OF RADIATION FROM A CO_2 LASER. Craig, A. D.; Nakai, S.; Summers, D. D. R.; Paul, J. W. M. (Culham Lab., Abingdon, Eng.). Phys. Rev. Lett.; 32: No. 18, 975-978(6 May 1974).

The scattering of CO_2 laser radiation by long-wavelength ($k\lambda_D \sim 0.1$) turbulent density fluctuations within a collisionless shock is described. The spectrum of the scattered radiation is shifted in wavelength from that of the incident laser beam, demonstrating genuine scattering rather than enhanced stray light. The observed level of fluctuations is a hundred times thermal but a thousand times lower than that to be expected from an extrapolation of the Kadomtsev spectrum observed previously for $k\lambda_D \sim 1$. (auth)

15112 THREE-WAVELENGTH HOLOGRAM DIAGNOSTICS OF AN OPTICAL BURST ON A POTASSIUM TARGET. Dreiden, G. V.; Zaidel, A. N.; Ostrovskii, Yu. I.; Shedova, E. N. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 7, 972-974(Jan 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 7, 1537-1542(Jul 1973).

Experiments involving three-wavelength interference holography diagnostics of the plasma of a laser burst on a potassium target are reported. The holograms are recorded using the fundamental radiation of a ruby laser (λ6943 Å), its second harmonic (λ3472 Å), and stimulated Raman scattering in nitrobenzene (λ7658 Å). The close proximity of the Raman wavelength and the resonant absorption line of potassium (λ7665 Å) increases by two orders of magnitude the sensitivity with which the potassium-atom density can be determined. The densities of electrons and atoms can be determined separately through the simultaneous use of the Raman line and the first and second harmonics of the ruby laser. (auth)

15113 ABSOLUTE MEASUREMENTS OF THE CONDUCTANCE OF PLASMA FORMATIONS. Punkevich, B. S. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 1, 104-106(Jan 1974).

Translated from Izmer. Tekh.; 17: No. 1, 63-64(Jan 1974).

A device and method are described for measuring the conductance of spherical symmetrical conducting volumes when a measuring coil is connected to a symmetrical high-frequency bridge. This method serves to distinguish a continuously conduct-

ing ball from a hollow conducting spherical layer of a given thickness with an insignificant skin effect in the conducting volume and to determine the thickness of this layer for a known conductance and diameter. Some measurements are described. (MOW)

15114 SCHLIEREN AND INTERFEROMETRIC INVESTIGATIONS OF GAS DISCHARGES WITH AUTOMATIC PROCESSING OF SCHLIEREN PHOTOGRAPHS AND INTERFEROGRAMS. Gerasimova, V. I.; Dushin, L. A.; Privezentsev, V. I.; Taran, V. S. Meas. Tech. (USSR) (Engl. Transl.); 17: No. 1, 100-103(Jan 1974).

Translated from Izmer. Tekh.; 17: No. 1, 61-63(Jan 1974).

The schlieren method was used along with an interferometric method in order to study the plasma obtained in a hydrogen discharge with a hollow cathode. The schlieren photographs were processed on a microphotometer. Electron density measurements are described. The use of an automatic two-gradation reading device is discussed. (MOW)

Kinetics (General)

Refer also to abstract 17429.

15115 MEASURED STARK BROADENING IN AN INTERMEDIATE DENSITY PLASMA. Chester, G. R. Austin, TX; Univ. of Texas (1973). 177p. University Microfilms Order No. 74-5212.

Thesis (Ph.D.).

Stark profiles for the Balmer series, through H_{10}, ranging from four orders of magnitude in intensity for H-Beta to two orders for H_{10}, were measured in a z-discharge over the electron density and temperature ranges 2 to 8×10^{14} cm^{-3} and 1 to 2 eV, respectively. Homogeneity measurements of the source showed that the electron density is uniform to within ±4% for 90% of the optical path. Boundary layer effects are believed to be negligible. The profiles were compared with the unified theory of Vidal, Cooper, and Smith and the modified impact theory of Kepple and Griem. Overall agreement between the experiment and theories was better than 5% for all lines studied. Measured core structure was always less pronounced than theoretical predictions. H-Beta, H-Delta, and H-Epsilon showed an indication of slightly faster wing slopes than the traditional 5/2. Despite satisfying the validity criterion for partial local thermodynamic equilibrium, the measured atomic state densities for principal quantum numbers four through ten were 40 to 250 times larger than the values calculated from the Saha–Boltzmann equation. (Diss. Abstr. Int., B)

15116 PLASMA-SOLID INTERFACE ENERGY TRANSPORT. Niimura, M. Fort Collins, CO; Colorado State Univ. (1973). 290p. University Microfilms Order No. 74-5438.

Thesis (Ph.D.).

A quantitative investigation was made of the arc energy transport across a plasma-solid interface. In particular, the effect of external and internal electric fields on the thermal conductivity was investigated, in detail. High electric fields exist at the interface due to the large gradients of the plasma parameters and departs the plasma from local-thermodynamic-equilibrium (LTE). This situation makes accurate energy transport calculations at the interface difficult. A unified theory to treat the effect of electric fields was developed by introducing a generalized thermal conductivity and/or generalized correction factor for the conventional thermal conductivity. The radial and axial energy equations including all the important transport terms and the field correction factors were evaluated. The state of plasma is described by a two-temperature gas in the high electric field regions. A comprehensive formula useful for the calculation of both the anode and cathode fall energy transports was presented. This thesis also presents the results of theoretical and experimental investigations of Thomson scattering technique as employed for the plasma-solid interface diagnostics. A direct method to measure energy transport coefficients from Thomson scattered laser line profiles has been proposed and the results of numerical calculations for the purpose are presented. Experimentally, the distribution of the electron temperature and density of an argon arc plasma at the reduced and atmospheric pressures was measured by Thomson scattering. From these data the degree of non-LTE and the anode fall energy transfer rate were calculated. The experimental results are discussed in relation to the theoretical predictions performed in this thesis. (Diss. Abstr. Int., B)

15117 REAL GAS EFFECTS ON INTERACTION OF SHOCK-HEATED PLASMA FLOWS WITH A TRANSVERSE MAGNETIC FIELD. Shiraishi, M.; Hashiguchi, S. (Hiroshima Univ.). J. Phys. Soc. Jap.; 35: No. 4, 1274(Oct 1973).

15118 EXPERIMENTAL STUDY OF WEAKLY IONIZED SUPERSONIC FLOW. II. Flow Past a Flat Plate with Sharp Leading Edge. Ikui, T. (Kyushu Univ., Fukuoka); Masuda, M.; Iwamoto, K. Mem. Fac. Eng., Kyushu Univ.; 33: No. 2, 37-46 (Oct 1973).

Experimental studies on the flow past a flat plate with sharp leading edge were conducted under two flow conditions, namely one of which was the supersonic flow of a single component gas ($M \approx 5$, $Re \approx 100$ 1/mm), and the other was that of a weakly ionized gas flow ($M \approx 9.5$, $Re \approx 5$ 1/mm) obtained by the direct current arc heater. The impact pressure probe and the cylindrical Langmuir probe were used to investigate the structure of flow field. From the experiments concerning the flow field of strong interaction to the merged layer region in a single component gas, it has been shown that the present results for the shock wave and the static pressure distribution on the surface of the plate coincide with the strong interaction theory by Cheng et al. Further, from the flow field surveys about the transition and the kinetic regions in the weakly ionized gas flow, the behavior of neutral and charged particles were obtained. (auth)

15119 LONGITUDINAL POLARIZATION AND FOCUSING OF PLASMOIDS IN A STRAIGHT MAGNETIC MULTIPOLE. Berezov, D. V.; Demidenko, I. I.; Lomino, N. S.; Padalka, V. G. (Physical-Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 752-755(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1184-1190(Jun 1973).

A study is made of the generation of longitudinal polarization fields in a plasmoid moving along the axis of a straight octupole field. Plasma drift is detected in crossed electric polarization and magnetic fields, along the normals to the magnetic surfaces. The drift direction is governed by the current direction in the linear conductors of the magnetic system with respect to the plasma flow. When the flow is antiparallel to the current, the moving plasma is focused by the straight multipole field. (auth)

15120 POLARIZATION INTERACTION OF OPPOSED PLASMA FLOWS IN A TOROIDAL MAGNETIC FIELD. II. Korzh, V. G.; Padalka, V. G.; Strashko, A. P. (Kharkov State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 756-758(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1191-1195(Jun 1973).

In a study of the polarization direction of opposed plasmoids in a toroidal magnetic field it is found that a weakening of the magnetic field at the point at which the plasmoids enter the system can significantly increase the efficiency of the polarization interaction of opposed plasmoids and can increase the efficiency with which the plasma is trapped in a system with a strong magnetic field. (auth)

15121 EXPERIMENTAL STUDY OF WEAKLY IONIZED SUPERSONIC FLOW. I. Flow Field Structure and Viscous Correction to Impact Probe. Ikui, T.; Masuda, M. (Kyushu Univ., Fukuoka). Mem. Fac. Eng., Kyushu Univ.; 33: No. 2, 23-36(Oct 1973).

Investigations of the operating characteristics of the low-density plasma wind tunnel with direct current arc heater and the rarefied flow effect on the impact probe are discussed. The wind tunnel is a continuous, open type with the under-expanded free jets from the supersonic nozzle at the test section. The stagnation pressure of the jet was evaluated with good accuracy by measuring the static pressure at the nozzle throat. From the test results using the impact and the Langmuir probes, it was found that the freestream Mach and Reynolds numbers were in the range from 5 to 9 and from 60 to 2000 (1/cm) respectively. The viscous or rarefied flow effects on the impact pressure reading in the high enthalpy flow were clarified. It was pointed out that the response characteristics of the impact tube was significantly affected by the stagnation enthalpy of the flow, and the method to eliminate the thermomolecular pressure effects was suggested. (auth)

Kinetics (Experimental)

15122 ANOMALOUS ELECTRICAL CONDUCTIVITY OF MAGNETIZED PLASMA. Barkov, A. P.; Burchenko, P. Ya.; Volkov, E. D.; Rudakov, V. A.; Tereshchenko, F. F. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 743-745(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1170-1173(Jun 1973).

An experimental study was made of the electrical conductivity of a plasma in a strong magnetic field. The onset of instability of the current-carrying plasma and the spectra of electric-field oscillations is studied. The saturation of the velocity in the magnetized plasma is measured. (auth)

15123 ELECTRON-DENSITY DISTRIBUTION AT THE PLASMA FOCUS OF A COAXIAL INJECTOR. Kozlov, N. P.; Leskov, L. V.; Protasov, Yu. S.; Khvesyuk, V. I. (Moscow Higher Technical School). High Temp. (USSR) (Engl. Transl.); 11: No. 4, 794-795 (1973).

Translated from Teplofiz. Vys. Temp. 11: No. 4, 883-884(1973).

The electron density at the plasma focus of an erosional-plasma accelerator was investigated. The diameter of the central electrode of the coaxial accelerator (the cathode) is 20 mm; the diameter of the outer electrode is 80 mm and its length is 40 mm. The discharge was initiated on the surface of a dielectric [Teflon (polytetrafluoroethylene)] using a low-power plasma injector of the Bostik type, placed at the inner electrode. A capacitor bank of capacitance 600 μF ensured, for a voltage of 5 kV, a current amplitude of order 340 kA. The discharge current increased up to its maximum in 11 μsec. The plasma was injected into a vacuum chamber 0.5 m in diameter and 3 m long, evacuated down to a pressure of 5×10^{-4} mm Hg. The electron density was measured using a shadow method based on the Topler schlieren method with photoelectric recording; the measurement diagram is represented. (MOW)

15124 DIRECT MEASUREMENT OF SKIN DEPTH OF ELECTROMAGNETIC WAVES IN A PLASMA. Masuda, M.; Minami, K.; Takeda, S. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 3, 949(Sep 1973).

Kinetics (Theoretical)

Refer also to abstract 15246.

15125 (BUM-40) KINETIC THEORY FOR EVOLUTION OF A PLASMA IN EXTERNAL ELECTROMAGNETIC FIELDS TOWARD A STATE CHARACTERIZED BY BALANCE OF FORCES TRANSVERSE TO THE MAGNETIC FIELD. Oeien, A. H. (Bergen Univ. (Norway). Dept. of Applied Mathematics). Apr 1973. 67p. Dep. NTIS (US Sales Only) $6.50.

Two parameters, ϵ and α, related to weak inhomogeneity and mass ratio between electrons and ions are considered in the kinetic and macroscopic equations for a two component, weakly coupled, weakly inhomogeneous electron–ion plasma in electromagnetic fields. For certain orderings between these parameters ($\epsilon \ll \alpha$) the plasma components evolve toward local equilibrium at the same temperature before the typical transport processes set in. An extreme such ordering is considered. Distribution functions and macroscopic functions are expanded in both parameters. Solutions of equations are discussed and it is shown in particular that when solutions of kinetic equations are assumed bounded on short effective collision time scales, the plasma evolves, so that forces transverse to the magnetic field in the mass velocity equation balance on longer time scales. (auth)

15126 (COO-2059-31) THERMAL RELAXATION OF A TWO-DIMENSIONAL PLASMA IN A DC MAGNETIC FIELD. Part I. Theory. Hsu, J. Y.; Montgomery, D.; Joyce, G. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1974. Contract AT(11-1)-2059. 14p. Dep. NTIS $4.00.

A theory is presented for the rate of thermal relaxation of a two-dimensional plasma in a strong uniform dc magnetic field. The Vahala–Montgomery kinetic description is completed by providing a cut off time for the time of interaction of two particles which contribute to the collision term. The kinetic equation predicts that thermal relaxation occurs as a function of the dimensionless time $(\omega_p t)$ (ω_p/Ω) $(n_\phi \lambda_D^2)^{-\frac{1}{2}}$, where ω_p is the plasma frequency, Ω is the gyrofrequency, and $n_\phi \lambda_D^2$ is the number of particles per Debye square. By contrast, in the absence of an external magnetic field, a two dimensional plasma relaxes as a function of $(\omega_p t)$ $(n_\phi \lambda_D^2)^{-1}$. (auth)

15127 (COO-2059-32) THERMAL RELAXATION OF A TWO-DIMENSIONAL PLASMA IN A DC MAGNETIC FIELD. Part II. Numerical Simulation. Hsu, J. Y.; Montgomery, D.; Joyce, G. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1974. Contract AT(11-1)-2059. 14p. Dep. NTIS $4.00.

The thermal relaxation process for a spatially uniform two-dimensional plasma in a uniform dc magnetic field is simulated numerically. Thermal relaxation times are defined in terms of the time necessary for the numerically computed Boltzmann H-function to decrease through a given part of the distance to its minimum value. Dependence of relaxation time on two parameters is studied: number of particles per Debye square $n_\phi \lambda_D^2$ and ratio of gyrofrequency to plasma frequency Ω/ω_p. When Ω^2/ω_p^2 becomes $\gg [\ln(L/2\pi\lambda D)]^{-\frac{1}{2}}$ where L is the linear dimension of the system, it is found that the relaxation time varies to a good approximation as $(n_\phi \lambda_D^2)^{\frac{1}{2}}$ and Ω/ω_p. (auth)

15128 (COO-2059-37) NUMERICAL AND ANALYTICAL INVESTIGATION OF NONLINEAR PROPERTIES OF THE VLASOV EQUATION. Progress Report. Knorr, G. E. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). May 1974. Contract AT(11-1)-2059. 14p. Dep. NTIS $4.00.

In the field of microscopic plasma simulation use was made of the fact that the Vlasov equation contains an operator with a continuous eigenvalue spectrum. In order to represent that spectrum for arbitrarily long times one needs arbitrarily many degrees of freedom. This is impossible on a finite computer. The results are either recurrence problems or the rise of statistical fluctuations. In order to avoid this some entropy producing term has to be introduced. One can then try to reduce the number of particles or mesh points in the computer while keeping the relevant physics. A review of papers published and topics investigated during this period is given. (auth)

15129 (ITF-74-21E) TRANSITION PROBABILITIES, CORRELATION FUNCTIONS AND DIELECTRIC PERMITTIVITY TENSORS FOR SEMIBOUNDED AND BOUNDED NONEQUILIBRIUM PLASMA. Yakimenko, I. P.; Zagorodny, A. G. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 28p. Dep. NTIS (U. S. Sales Only) $4.50.

The spectral tensors of current fluctuations in the systems of uncorrelated particles and the linear response functions are derived on the basis of the transition-probability approach to the theory of nonequilibrium plasma semi-bounded or bounded in one direction. The typical cases of nonequilibrium systems are considered including the presence of directed particle flows, external force fields and temperature anisotropy. The statement of the boundary value problem for the fluctuation fields in plasma half-space and layer is also discussed under the condition that the particles suffer the specular reflection near the boundaries. The results obtained are assigned for constructing the correlation theory of electromagnetic processes in bounded nonequilibrium plasma. (auth)

15130 (ITF-74-23P) ELECTROMAGNETIC FLUCTUATIONS IN THE HALF-SPACE OF NONEQUILIBRIUM PLASMA. Popov, V. S.; Yakimenko, I. P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The boundary value was solved for the fluctuational field in the case when the electrons drift as a whole relative to the ions. The spectral densities of the space correlations of electron, ion, and total charges were found. The frequency domains in which plasma is transparent were investigated in detail. It was indicated that the introducing of plasma boundary affects strongly the fluctuation spectrum in such domains; in particular, the possibility of the existence of new branches (in respect to the case of unbounded plasma) of critical fluctuations was predicted. (auth)

15131 (ORNL-TM-4605) APPROXIMATE FOKKER–PLANCK OPERATORS FOR COULOMB COLLISIONS. Sigmar, D. J.; Clarke, J. F.; Hirshman, S. P. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 36p. Dep. NTIS $5.00.

Analytically tractable approximations are developed for C_{ee} (or C_{ii}) and C_{ie}, where C_{ab} is the operator for collisions of species a on b, (e stands for electrons, i for ions). Whereas the pitch angle derivatives $\partial/\partial\theta$ contained in these operators are kept rigorously, a global method of describing the effect of velocity derivatives $\partial/\partial v$ in algebraic terms is developed. The resultant form for C_{ie} when generalized to the case of heavy ions colliding with light ions enables the analytic solution of the multi-ion species transport problem. The result for C_{ee} (or C_{ii}) agrees with a previously given heuristic derivation. These operators obey the conservation laws. Their use is restricted to kinetic equations of the generalized Spitzer–Haerm type for which $(\partial^2 f/\partial v^2) \propto (1/v^2)$ $(\partial^2 f/\partial\theta^2)$. This includes the neoclassical transport problem for plasmas in toroidal magnetic confinement in the long mean free path ("banana") regime. (auth)

15132 (ORNL-TM-4606) EFFECT OF CHARGE EXCHANGE REACTIONS ON NEOCLASSICAL TRANSPORT. Sigmar, D. J.; Clarke, J. F. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 35p. Dep. NTIS $4.75.

A collision operator for the reaction H^+ (hot) + H^0 (cold) $\rightleftharpoons$ H^0 (hot) + H^+ (cold) is derived from the Boltzmann integral and incorporated in the proton drift kinetic equation for a toroidally confined plasma in the banana regime. In addition to the proton diffusion, the relaxation of the radial electric field and the parallel flow velocity is calculated and shown to occur in a few charge exchange times, much faster than via perpendicular ion viscosity. (auth)

15133 (RISO-301) INVESTIGATIONS OF PLASMA DIELECTRIC FUNCTIONS. Pecseli, H. L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

Some general relations concerning dielectric functions can be obtained using an analysis well known from electric network theory. On the basis of these relations a general discussion of wave stability and wave energy is presented. (auth)

15134 (UCID-16517) ANALYTIC MODEL OF CYLINDRICAL METAL LINER COMPRESSION OF DT PLASMA. Shearer, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1974. Contract W-7405-eng-48. 32p. Dep. NTIS $4.75.

An analytical model is formulated to give an approximate description of metal liner compression of DT-plasma (and magnetic field) in cylindrical geometry. The model includes a correction for liner compression. Calculations are carried out for a copper liner. "Breakeven" conditions are found for a pure fusion system and for a hybrid system with a fission blanket. The results show that a pure fusion system requires gigajoules of energy per explosion, but the hybrid system needs only megajoules of energy per explosion. (auth)

15135 (UCID-16527) SPACE CHARGE LIMITING OF BOUNDED RELATIVISTIC ELECTRON BEAMS. Fessenden, T. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 May 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

It is assumed that because of a sufficiently strong axial magnetic field, the electrons are constrained to move only in the direction of beam propagation. Thus $\beta_\perp = 0$ and $\beta_z = \beta = \sqrt{1 - 1/\gamma^2}$. Here β is v/c and γ is the ratio of the electron mass to its rest mass. It is further assumed that the charge density of the beam (ρ) is uniform in the region $0 \leq r \leq a$ and that the beam is inside a conducting pipe of radius b. With these hypotheses, Poisson's equation is then solved. The following cases are considered: (1) uniformly filled pipe, (2) thin beam limit, and (3) for arbitrary ratios of beam to pipe radius. (MOW)

15136 (UCRL-74926) TWO-DIMENSIONAL CALCULATIONS OF HIGH DENSITY LASER INDUCED FUSION: STUDY OF SYMMETRY AND TAYLOR INSTABILITY. Zimmerman, G. B.; Thiessen, A. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Oct 1973. 6p. (CONF-731009-9). Dep. NTIS $4.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

The LASNEX fusion code is briefly discussed. The code allows one to explore the effects of decoupling and preheat caused by nonequilibrium electron and photon distributions. By considering two spatial coordinates questions concerning symmetry, stability, and self-generated magnetic fields are studied. Some calculations using the LASNEX code are discussed. (MOW)

15137 COMPUTATIONAL SIMULATION OF PLASMAS FOR CTR. Dawson, J. M. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 18: 130(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15138 FLUID SIMULATION MODELS FOR CTR PLASMAS. Boris, J. P. (Naval Research Lab., Washington, DC). Trans. Amer. Nucl. Soc.; 18: 130-131(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15139 PLASMA SIMULATIONS USING PARTICLE CODES. Kruer, W. L. (Lawrence Livermore Lab., Livermore, CA). Trans. Amer. Nucl. Soc.; 18: 131(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15140 IRROTATIONAL MOTION OF A HOT UNSTEADY PLASMA. Ionescu-Pallas, N. J.; Alexandrescu, R.; Cojocaru, E.; Covaciu, M.; Mihailescu, I. N.; Popescu, I.; Velculescu, G. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 3, 365-367(1974).

Differential equations are given that describe a nonstationary expanding plasma under certain circumstances encountered in high-energy laser pulse experiments. The following requirements were assumed: (1) the plasma is strongly ionized, (2) it expands freely in a radial motion, (3) there is a lte between the kinetic energy and the radiation stored in the plasma, (4) dissipation takes place at a constant rate, and (5) internal friction is accounted for in a Newtonian manner. (MOW)

15141 DIELECTRIC CONSTANT OF A PLASMA WITH NON-AZIMUTHAL TRANSVERSE CURRENTS. Logvinov, V. V.; Machabeli, G. Z. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 591-594(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 930-937(May 1973).

The dielectric-constant tensor is calculated for arbitrary wavelength assuming translational motion of the particles perpendicular to the magnetic field. (auth)

15142 KINETIC THEORY OF THE ACOUSTICAL WIND IN PLASMA. Trofimov, V. G. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 2, 131-137(1974). (In Russian).

On the basis of the Vlasov equation the possibility of obtaining an electroacoustical wind in the system was examined. The steady flow of particles is obtained in the second amplitude approximation of the perturbation potential. The particles are not attenuated in contrast to its expression in the original perturbation approximation. (tr-auth)

15143 ELECTROCONDUCTIVITY TENSOR OF A MAGNETOACTIVE PLASMA. Cristea, M. Stud. Univ. Babes-Bolyai, Ser. Phys.; 19: No. 1, 45-58(1974). (In Rumanian).

The electroconductivity tensor for a weakly ionized, infinite, homogeneous, magnetoactive plasma was calculated. The collision term of the kinetic equation has the simplified form proposed by Bhatnagar et al. Some particular cases are studied. (tr-auth)

15144 STEPWISE EXCITATION AND LOCAL THERMODYNAMIC EQUILIBRIUM ON EXCITED HYDROGEN LEVELS IN HELIUM-HYDROGEN PLASMA BEHIND SHOCK FRONT. Fukuda, K.; Sugiyama, I.; Okasaka, R. (Kyoto Univ.). J. Phys. Soc. Jap.; 35: No. 4, 1202-1211(Oct 1973).

The calculation is carried out on the ionization relaxation as well as on the time developments of population densities of excited hydrogen levels for helium-atomic hydrogen mixtures (H: 0 ~ 3 atomic %) behind the reflected shock front under the conditions of the experiment with an electromagnetic T-tube conducted by the present authors. The result gives the shortening of ionization relaxation time depending on mixing ratio of hydrogen and the characteristic initial hump in time development of population density, which is remarkable for low-lying excited levels of hydrogen in a mixture of low hydrogen mixing ratio. The temporal changes of the population and depopulation rates in the relaxation zone are presented for several excited hydrogen levels so that the existence of stepwise excitation between the coronal equilibrium and LTE is illustrated and the validity criterion is proposed for the establishment of LTE. (auth)

15145 RELATIVISTIC GENERALIZATION OF THE DARWIN LAGRANGIAN. Trubnikov, B. A.; Kosachev, V. V. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 4, 1311-1315(Apr 1974). (In Russian).

A model Lagrangian which formally describes charge interaction for any degree of relativism was obtained for an optically thin plasma in which the action of radiated fields on the charges can be neglected due to rapid emission of the fields. (auth)

15146 INCLUSION OF ELECTRON DEGENERACY IN A PSEUDOPOTENTIAL MODEL OF A NONIDEAL PLASMA. Filinov, V. S. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 4, 780-782(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 4, 871-874(1973).

A further development of an earlier theory is presented which takes into account degeneracy and quantum effects in the interaction between electrons in a highly nonideal plasma. The model is based on an expression for the density matrix of the system which is antisymmetric with respect to the electron coordinates. The group operator identity $\exp[-\beta\hat{H}] = \exp[-(\beta/n)\hat{H}]^n$, where $\hat{H}$ is the Hamiltonian of the system, and the possibility of obtaining an analytic expression for the high-temperature density matrix means that the necessary relations can be written in explicit form. The MCM was modified so that calculations in the model could be performed for Fermi systems when $n\lambda^3 < 1$. Preliminary results of the calculation of the equation for ionization equilibrium are given. It should be noted that an increase in nonidealness leads to a breakdown of the convergence of the Markov chains. This phenomenon is explained by the appearance of quantum effects in the electron interactions and indicates that a phase transition is possible. The calculations are compared for both weak and strong degeneracy. (MOW)

15147 KINETIC EQUATION FOR A CLASSICAL MONIDEAL PLASMA. Shibata, M.; Ichimaru, S. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1120-1131(Oct 1973).

The Balescu-Lenard theory of plasma kinetic equation is reformulated in such a way that the resulting collision term now conserves the sum of the kinetic and potential energy to the first order in the plasma parameter. The new collision term is expressed in terms of the instantaneous values of the single-particle distribution function and its first derivative in time. (auth)

15148 VELOCITY AUTOCORRELATION FUNCTION AND DYNAMICAL STRUCTURE FACTOR OF THE CLASSICAL ONE-COMPONENT PLASMA. Hansen, J. P. (Universite de Paris,

Orsay, France); Pollock, E. L.; McDonald, I. R. Phys. Rev. Lett.; 32: No. 6, 277-280(11 Feb 1974).

Molecular-dynamics computations are presented of the velocity autocorrelation function and the dynamical structure factor of the classical one-component plasma. At high densities, the former exhibits marked oscillations, whereas the latter consists of very sharp peaks near the plasma frequency, up to wave vectors of order 1/a, where a is the ion-sphere radius. The resulting dispersion curve is discussed. (auth)

15149 ELECTROMAGNETIC FIELD IN A COLLISIONLESS PLASMA CLOSE TO A SOLID WALL. Fiszdon, W.; Piechor, K. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 22: No. 3, 245-250(1974).

The influence of electron-solid surface interactions on the electromagnetic field is considered on the basis of the linearized Vlasov–Maxwell equations. Sufficient conditions for existence and uniqueness of solutions of these equations are given. The electric field in the "cold" semibounded plasma is investigated in detail. The analysis shows the existence of a "boundary layer" close to the wall, caused by thermal motions of electrons. (auth)

Production

Refer also to abstracts 15112 and 15733.

15150 (AEC-tr-7551) PSEUDO CONSTANT ARC PLASMA FLOW. Kuriki, K.; Suzuki, T.; Inutake, M. (Kyoto Univ. (Japan)). 1970. Translated from Symposium on Magnetohydrodynamics, Tokyo, Japan, 12–13 February 1970. 8p. Dep. NTIS $4.00.

The construction of a pseudo constant arc plasma generator plus experiments to determine the suitability of this type of generator to various fields of plasma physics research are outlined. (auth)

15151 (SLA-73-7064) LASER PLASMA STUDIES WITH THE SANDIA FOUR-BEAM SYSTEM. Brannon, P. J.; Cano, G. L.; Cuderman, J. F.; Glibert, K. M.; Hohlfelder, J. J.; Jones, E. D.; Palmer, M. A.; Powell, J. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 17p. (CONF-740617-4). Dep. NTIS $4.00.

From 8th international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

Four-beam laser interaction experiments were conducted using CD_2 spheres at laser energies on target of 30 to 40 J/beam in a 0.97 nsec pulse. From 45 to 75% of the energy on target is absorbed depending upon the pellet size. Neutrons were observed coming from the walls but not from regions near the target. High-energy electrons have been directly observed with a magnetic spectrometer and assuming symmetric emission on the average account for less than or equal to a millijoule of the absorbed energy. Fast and slow groups of ions are seen in the expanding plasma, the fast group containing as much as 27% of the absorbed energy for 100 micrometer spheres. Average ion velocities approach 6×10^7 cm/sec indicating the pellets expand substantially during the course of the heating pulse. (MOW)

15152 PLASMA PRODUCTION FROM A CESIUM ADSORBED LAYER BY A PARALLEL LASER BEAM. Yamauchi, T.; Okuda, T. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 4, 1270 (Oct 1973).

15153 PRODUCTION AND PHYSICAL PROPERTIES OF CESIUM PLASMA BY RESONANCE ADSORPTION. Yamasa, J.; Okuda, T. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 3, 881-884(Sep 1973).

For the purpose of producing cesium plasma, cesium vapor was irradiated by the resonance radiation from the outside. By the resonance radiation, the Cs atoms are excited to the doublet resonance levels, $6P_{\frac{1}{2}}$ and $6P_{\frac{3}{2}}$ and then are ionized through the collision process. Under these conditions, a quiescent current-free plasma with a moderate density of the order of 10^{12} cm^{-3} was obtained. It was confirmed that the dissociative recombination is a dominant process of the plasma decay and the molecular ion is dominant species. The radial distributions of the electron density have a minimum at the center of the tube. (auth)

15154 MACROSCOPIC PICTURE OF LASER PRODUCED PLASMA. Ionescu-Pallas, N. J. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 3, 305-327(1974).

A complete set of macroscopic equations is derived in view of depicting the radial expansion of a laser-produced plasma in empty space. The hypotheses concerning the discarding of ionization energy and that concerning the assimilation of inner frictions to some additional pressures were carefully analyzed. Microscopic arguments are also brought to support the proposed evolution equations. Numerical computations for a point-like focusing and a constant intensity over the pulse duration give, with some subsidiary approximations, a correct prediction of the magnitude order of neutron yielding rate in a high-energy unsteady deuterium plasma. (auth)

15155 HIGH FREQUENCY BRILLOUIN SCATTERING IN METALS AND GASEOUS PLASMAS. Srivastava, S. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 3, 107-115 (Mar 1974).

Spontaneous and stimulated Brillouin scattering are studied in metals and gaseous plasmas, for an incident laser frequency ω_l greater than the corresponding plasma frequency ω_{pl} in the medium. The calculation of threshold powers for the stimulated scattering in aluminum metal and non-degenerate Al-plasmas shows that their values become quite small as ω_l approaches ω_{pl}. For the case of backward wave scattering we also estimate the critical power above which a temporal instability sets in such media. It is argued that this instability may be one of the factors for anomalously large absorption of high power laser beams in laser-induced plasmas. (auth)

15156 IGNITION CONDITION FOR A SUPERDENSE PLASMA. Caruso, A. (Comitato Nazionale per l'Energia Nucleaire, Frascati, Italy). Plasma Phys.; 16: No. 7, 683-684(Jul 1974).

Recently a method has been proposed to generate very high density DT plasmas ($n \sim 5 \times 10^{26}$ cm^{-3}) by focusing several laser beams on a pellet. The ignition conditions for superdense systems can be quite different from those usually considered; a reason for this is that radiative losses cannot be described as bremsstrahlung. Some limiting situations in which very simple criteria for ignition can be given are considered. In particular the case of a superdense plasma radiating as a black body is studied. In the analysis it is also implicitly assumed that these radiative losses are not compensated by the absorption of the bremsstrahlung emitted by the outer low density plasma. Two cases are considered: (1) black body with space-independent temperature and, (2) a system with losses described, at a dimensional level, by radiative transfer. (auth)

Stability

Refer also to abstracts 15136 and 15229.

15157 (COO-3004-6) INVESTIGATIONS IN PLASMA DYNAMICS. Annual Progress Report, September 15, 1973–September 15, 1974. Schmidt, G. (Stevens Inst. of Tech., Hoboken, N. J. (USA)). 1974. Contract AT(11-1)-3004. 9p. Dep. NTIS $12.25.

The following programs are discussed: (1) The properties of the beam–plasma instability in a nonuniform medium were investigated. It was found that a threshold current exists for instability depending on the nonuniformity. For a given beam the instability is quenched if the (say) density gradient in the plasma is large, in agreement with experimental results. (2) The three-wave resonant parametric instability (say backscattering) in a finite medium, including pump depletion, was studied numerically. It was found that after transients the system settles down into a dynamic stationary equilibrium. While analytically many such equilibria exist, it was found that only one of those is stable. (3) A review paper on parametric instabilities was prepared and presented as an invited paper on an AGARD-NATO meeting. The underlying physical mechanisms of these instabilities were explained. (4) In cooperation with an Indian group a new instability, arising when a magnetically confined plasma is heated by a laser beam, was investigated. The stable and unstable parameter regimes were found. (auth)

15158 (IPP-1/145) IDEAL MHD INSTABILITIES AS AN INITIAL BOUNDARY-VALUE PROBLEM. Bateman, G.; Schneider, W.; Grossmann, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Apr 1974. 46p. Dep. NTIS (US Sales Only) $5.50.

The gross MHD instabilities of straight cylindrical plasmas with elongated cross-section were investigated by solving the linearized MHD equations as an initial boundary-value problem on the computer. The linearized equations are Fourier analyzed along the ignorable coordinate of the equilibrium in order to reduce the computation to two dimensions. The method is applied to find the fixed-boundary instabilities of an equilibrium with rectangular walls. Starting with an arbitrary initial perturbation and following it for many Alfven transit times, one finds that the dominant instability overwhelms all stable oscillations after several e-folding times. The growth rates of the fastest growing instabilities are examined as a function of the equilibrium parameters. The spatial structure of the physical variables (v^1, B^1, p^1) are found. One finds that the

cross section of the velocity field displays a distinctive convection pattern. This structure becomes spatially concentrated around the point of maximum rotational transform as the equilibrium current is decreased to the marginal point and concentrates near the wall as the current is increased. Given the equilibrium $p'(\psi) = J_{zc}\,\psi/\psi_c$. $\psi(\text{wall}) = 0$, one finds that the marginal current density J_{zc} for each mode increases as the cross section is elongated. But the growth rates of the higher azimuthal m-modes increase with elongation and their intervals of instability overlap with the lower m-modes. (auth)

15159 (IPP-2/221) FREE-BOUNDARY HELICAL EQUILIBRIA. Barberio-Corsetti, P. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Apr 1974. 21p. Dep. NTIS (US Sales Only) $4.25.

The MHD equilibria of helically symmetric, current-carrying plasmas were investigated. Configurations such as straight helical pinches or high-β stellarators (where the plasma column is surrounded by a force-free region) are considered in the sharp-boundary, flat-pressure-profile approximation. The plasma current and pressure can be large. The appropriate boundary conditions are imposed by solving a self-consistent double-free-boundary problem in the approximation of an almost circular, otherwise arbitrary cross section. The helical field can be an arbitrary superposition of small helical field components with different e-numbers and equal winding period length. The plasma boundary determines the external currents or vice versa. (auth)

15160 (MATT-1049) PARAMETRIC INSTABILITIES AND ENHANCED HEATING OF PLASMA IN A MAGNETIC FIELD: A REVIEW. Porkolab, M. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Jun 1974. Contract AT(11-1)-3073. 21p. (CONF-740642-1). Dep. NTIS $4.25.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

Recent developments in the theory of parametric instabilities, experimental evidence of their existence, and their relation to plasma heating are reviewed. Only modes existing in magnetically confined plasmas are discussed, since these modes may be candidates for possible application to heat fusion plasmas with high power radio-frequency sources. Thus, particular attention is given to the regime of Trivelpiece–Gould modes, lower-hybrid frequency, ion-cyclotron frequency (fast magnetosonic wave), and upper-hybrid frequency. (auth)

15161 (N-73-32562) LOW-FREQUENCY INSTABILITIES AND PLASMA TURBULENCE. Ilic, D. B. (Stanford Univ., Calif. (USA). Inst. for Space Research). Jul 1973. 143p. (NASA-CR-135669; SU-IPR-534). NTIS $9.25.

A theoretical and experimental study is reported of steady-state and time-dependent characteristics of the positive column and the hollow cathode discharge (HCD). The steady state of a non-isothermal, cylindrical positive column in an axial magnetic field is described by three moment equations in the plasma approximation. Volume generation of electron-ion pairs by single-stage ionization, the presence of axial current, and collisions with neutrals are considered. The theory covers the range from the low pressure, collisionless regime to the intermediate pressure, collisional regime. It yields radial profiles of the charged particle velocities, density, potential, electron and ion temperatures, and demonstrates similarity laws for the positive column. The results are compared with two moment theories and with experimental data on He, Ar and Hg found in the literature for a wide range of pressures. A simple generalization of the isothermal theory for an infinitely long cylinder in an axial magnetic field to the case of a finite column with axial current flow is also demonstrated. (auth)

15162 (UCID-16510) DESTABILIZATION OF LOW-FREQUENCY DRIFT WAVES IN THE BASEBALL II EXPERIMENT. Futch, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 May 1974. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

J. F. Clarke (Phys. Rev. Lett. 23, 1215 (1969)) has discussed a mechanism for coupling between a low-frequency drift wave and an ion-cyclotron instability. He assumes that a high-frequency ion-cyclotron instability results in both electron losses and a fluctuating potential ϕ_{rf} having a perturbed component ϕ'_{rf}. This perturbed potential modulates the confining potential well for the electrons. The resulting perturbed electron loss rate renders one branch of the flute unstable. Clarke states that "the lower branch of the drift wave is unstable when coupled to electron loss by the microinstability in the manner postulated." In going through the algebra, the author concludes that the upper branch (ion wave) is unstable instead of the lower branch. The algebra is presented so that it may be checked by others in hopes of resolving the discrepancy. (MOW)

15163 THEORY OF PLASMA INSTABILITIES. Volume 1. Instabilities of a Homogeneous Plasma. Mikailovskii, A. B. Studies in Soviet Science. New York; Plenum Publishing Corporation (1974). 305p. $32.50.

Translated from Russian by Julian B. Barbour.

The following chapters are included: (1) instabilities of a cold homogeneous plasma, (2) kinetic description of plasma oscillations and general conditions of stability and instability, (3) kinetic instabilities, (4) spatially localized perturbations in an unstable plasma and the amplification of waves, (5) influence of plasma inhomogeneity on instability, (6) instabilities of a collisional plasma, (7) permittivity of a plasma in a magnetic field, (8) branches of electrostatic oscillations of a plasma in a magnetic field, (9) plasma with longitudinal electron beams, (10) plasmas with non-Maxwellian electrons, (11) plasmas with a group of non-Maxwellian electrons, (12) plasmas with a longitudinal current, (13) plasmas with a transverse current, (14) hf instability of plasmas with a non-Maxwellian transverse velocity distribution of the ions, (15) plasmas with anisotropic ions, (16) growth of ion cyclotron oscillations in a plasma with transversely non-Maxwellian ions, and (17) excitation of ion–cyclotron oscillations by ion beams. (MOW)

15164 THEORY OF PLASMA INSTABILITIES. Volume 2. Instabilities of an Inhomogeneous Plasma. Mikailovskii, A. B. Studies in Soviet Science. New York; Plenum Publishing Corporation (1974). 331p. $32.50.

Translated from Russian by Julian B. Barbour.

The following chapters are included: (1) gradient mechanisms of excitation of oscillations and their role in beam–plasma interaction processes, (2) ion cyclotron and hf instabilities in plasma with finite Larmor radius, (3) weakly inhomogeneous collisionless plasma, (4) equations of the oscillations of a collisional plasma, (5) instabilities of a collisional plasma, (6) plasmas in a gravitational field, (7) plasma in crossed electric and magnetic fields, (8) plasmas in fields with shear, (9) influence of shear on the instability of a plasma in a gravitational field, (10) weakly ionized plasma, (11) role of magnetic drift on plasma stability, (12) instabilities in curved fields, (13) cylindrical plasma column, (14) energy method investigation of plasma stability in adiabatic traps, (15) non-MHD instabilities in adiabatic traps, (16) plasmas in multipole traps, (17) plasmas in closed traps with magnetic surfaces and no current, and (18) plasmas in closed traps with magnetic surfaces and a current. (MOW)

15165 DECAY INSTABILITY OF PLASMA IN CROSSED FIELDS. Farenik, V. I.; Vlasov, V. V.; Rozhkov, A. M.; Kozharin, A. A. (Kharkov State Univ.). Czech. J. Phys.; 24: No. 6, 632-635(1974).

It is shown that in plasma placed in crossed electric and magnetic fields, oscillations are excited with the frequency close to the drift frequency $\omega_\varphi = k_\varphi v_\varphi$. Decay of the oscillations into two other oscillations, for which the selection rules $\omega_\varphi = \omega_2 - \omega_1$ and $m_\varphi = m_2 - m_1$ hold, where the frequency ω_1 is close to the Langmuir frequency of ions, was observed. (auth)

15166 RAYLEIGH–TAYLOR INSTABILITY OF A STRATIFIED PLASMA. Srivastava, K. M. (Kernforschungsanlage, Juelich, Ger.). Z. Naturforsch.; 29a: No. 3, 518-523(Mar 1974).

The effect of finite Larmor radius on the Rayleigh–Taylor instability was investigated for a semi-infinite, compressible, stratified and infinitely conducting plasma. The plasma is assumed to have one-dimensional density and magnetic field gradients. The eigenvalue problem has been solved using the Boussinesq approximation for disturbances parallel to the magnetic fields. It was established that for perturbation parallel to the magnetic field, the system is stable for both stable and unstable stratification. For perturbations perpendicular to the magnetic field, the problem was solved without the Boussinesq approximation. The dispersion relation was discussed in the two limiting cases, the short and long wave disturbances. It was observed that the gyroviscosity has a destabilizing influence from $k = 0$ to $k = 4.5$ for $\beta^* = 0.1$ and for $\beta^* = 0.1$ up to $k^* = 2.85$ and then onwards it acts as a stabilizing agent. It has a damping effect on the short wave disturbances. For some parameters, the largest imaginary part was shown. (GE)

15167 PARAMETRIC EXCITATION OF A PLASMA INSTABILITY BY MODULATION OF ITS DAMPING COEFFICIENT. Keen, B. E. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 16: No. 7, 557-563(Jul 1974).

Results are presented which show that a previously damped ion-sound instability (ω_0) can be parametrically excited in a plasma by modulating the damping coefficient at a frequency $\omega_1 \approx 2\omega_0$. In this case, the damping coefficient is varied between a positive value and a negative value, and, in fact, this coefficient must be negative for some fraction of a cycle, for parametric excitation to

occur. It is found that a certain threshold modulation depth, h, is required before parametric excitation occurs. At larger values of h, a classical symmetrical parametric resonance curve (instability amplitude versus frequency) is observed. However, at very large values of h, non-linear behavior is apparent. In this case, the parametric resonance curve becomes asymmetric and the nonlinear phenomena of "jumps" and its associated hysteresis effect is observed. A theory developed to describe this ion-sound instability under various conditions is compared with the experimental results, and good qualitative agreement is obtained. (auth)

15168 FLUCTUATION LEVELS CONNECTED WITH REACTIVE MARGINAL INSTABILITIES. Minardi, E. (UKAEA Research Group, Abingdon, Eng.). J. Plasma Phys.; 11: No. 3, 471-483(Jun 1974).

The problem is considered of the analytical calculation of the fluctuation level of the collective electric field in the case of a collisionless nondissipative plasma subject to a reactive marginal instability. The existence of this instability only depends on the negative sign of the real part of the dielectric constant ϵ and is not related to the dispersive or dissipative effects described by the frequency dependence or the imaginary part of ϵ. A typical example is given by the nonresonance two streams instability with a symmetric distribution function. In this situation the methods of the thermodynamics of Vlasov systems can be applied to calculate the fluctuation level connected with the instability, provided the Vlasov system is near enough to the marginally stable state and the effect of mode coupling can be neglected (at least for a certain time). In the linear limit, the unstable equilibrium is associated with a minimum of the entropy. When the instability develops new nonlinear terms appear in the dielectric coefficient ϵ, related to the inhomogeneization of the system associated with the growing collective field. These nonlinear terms counterbalance the negative sign of the linear part of ϵ, leading to a saturation of the instability. A neighboring inhomogeneous equilibrium with long wavelength is then realized, which corresponds to a maximum of the entropy and is stable (under the assumed approximations). The corresponding electrostatic potential is proportional to $u-u_c$, where u is the velocity corresponding to the maxima of the two-stream distribution and u_c is the critical value of u for the onset of the instability. The results of the thermodynamic method for the neighboring equilibria are compared with those obtained by solving the stationary Vlasov equation with conventional analytical methods or with computer calculations. (auth)

15169 PURELY GROWING ELECTROMAGNETIC MODES IN HIGH-BETA PLASMAS. Lakhina, G. S.; Buti, B.; Nayar, G. (Physical Research Lab., Ahmedabad, India). J. Plasma Phys.; 11: No. 3, 461-470(Jun 1974).

Electromagnetic waves propagating transverse to an external magnetic field in a high-β (β being the ratio of the kinetic pressure to the magnetic pressure) plasma become unstable through purely growing modes when $\beta_{||_e}$ (electron β parallel to the magnetic field) exceeds a certain minimum value $\beta^*_{||}$. For $J \leq 2$ (J being the distribution index), the region of instability consists of a single band of unstable wavenumbers k, whereas for $J \geq 3$ more than one unstable wave number band may exist. The growth rates are largest for J = 0, and tend to decrease as J increases. The presence of hot ions increases the instability region by exciting a low-frequency instability. This instability gets excited at considerably lowered values of $\beta_{||_e}$, and has growth rates of the order of ion cyclotron frequency. The effect of $T_{||}/T_{||_e}$ and $T_{||_e}/T_{\perp_e}$ is destabilizing, whereas that of $T_{\perp_i}/T_{\perp_e}$ is stabilizing. (auth)

15170 "INNER" REGION SOLUTION FOR THE RESISTIVE TEARING INSTABILITY INCLUDING "PARALLEL" VISCOSITY AND COMPRESSIBILITY. Marinoff, G. H. (West Australian Inst. of Tech., South Bently). J. Plasma Phys.; 11: No. 2, 253-268(Apr 1974).

A theoretical derivation to obtain an expression for the logarithmic derivative $\Delta(Q)$ of the "inner" or resistivity region has not been attempted for the resistive tearing instability where "parallel" viscosity has been included, although similar derivations have been done using "perpendicular" viscosity type terms. Such a derivation is presented, along with a numerical procedure for evaluating $\Delta(Q)$. Numerical results have been obtained for a hard-core pinch configuration. The resultant graphs show branch-point behavior that suggests stabilization due to "parallel" viscosity at high temperature. (auth)

15171 LINEAR STABILITY OF MODULATED PLASMA PROFILES. Croci, R.; Saison, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 16: No. 7, 603-616(Jul 1974).

The linear electrostatic stability of a low-β collisionless plasma in a magnetic field $\vec{B} = \vec{l}_z B_0$ is studied. Distribution functions of the type: $f_{0j} = n_0 g(v_\perp^2; v_{||}^2)[1 + 2\alpha \cos(\alpha[x + v_y/\Omega_j])]$ $\alpha \leq 1/2$; $\Omega_j = [(eB_0/m_j c)]$ $j = e,i$ are considered. The Laplace-Fourier transform of the electric potential is a meromorphic function whose poles in Fourier space are given by: $D(\omega; \vec{K}; \alpha^2, |a|) = 0$ where the functional D is a convergent infinite continued fraction. The above dispersion relation permits study of the two wavelength ranges ($|K_x v_{\perp_{th}}/\Omega|_i \gtrsim 1$ and $K_x(n'/n)^{-1} \sim 1$), which are left aside in the usual local theories. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstract 15267.

15172 (AEC-tr-7560) STATIONARY SYSTEM WORK PROGRAM FOR 1975-1980. Kadomtsev, B. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). [nd]. Translated from Russian. 14p. Dep. NTIS $4.00.

An outline is given for a proposed research program for the engineering development of a controlled thermonuclear reactor. The present research programs are described and future areas of research needed are discussed. A brief outline of Russian research is given. (MOW)

15173 (BNL-18866) SURVEY OF APPLICATIONS OF FUSION POWER TECHNOLOGY TO THE CHEMICAL AND MATERIAL PROCESSING INDUSTRY. Steinberg, M.; Beller, M.; Powell, J. R. (Brookhaven National Lab., Upton, N. Y. (USA)). May 1974. 103p. Dep. NTIS $8.25.

An initial survey of the application of controlled thermonuclear fusion power technology to the chemical and material processing industry was made. The general principles concerning the forms of energy, the energy conversion efficiency terms, and the process design criteria, were categorized, defined, and evaluated. A survey of potential, conventional, and advanced chemical processes is presented and capacity projections are made to the year 2000. (auth)

15174 (BNWL-SA-4865) CONCEPTUAL DESIGN OF A FUSION-FISSION HYBRID REACTOR BASED ON A MIRROR FUSION REACTOR WITH A SUBCRITICAL GAS COOLED FISSION BLANKET. Wolkenhauer, W. C.; Leonard, B. R. Jr.; Sutey, A. M.; Moir, R. W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. 22p. (CONF-740402-43). Dep. NTIS $4.25.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

One logical step in the development of controlled thermonuclear reactors may be the design of a hybrid fusion-fission reactor wherein the neutron-rich fusion source drives a fission assembly. To explore this concept as it applies to the mirror confinement, staff members of Lawrence Livermore Laboratory (LLL) and Pacific Northwest Laboratories (PNL) have joined together to develop a conceptual design of a mirror hybrid. The design currently has the following general characteristics: (1) the device will employ a sub-Lawson ($n\tau \simeq 3.0 \times 10^{13}$ cm^{-3} sec) plasma; (2) the fissile blanket will be subcritical by a fraction which is large compared to the delayed neutron fraction; (3) the device will have an overall output to input energy ratio substantially greater than unity; and (4) the device will breed both fusion fuel (tritium) and fissile fuel (plutonium). In addition to the above general characteristics, the design is based in large part upon presently understood technology rather than extrapolation to expected future technology. (auth)

15175 (BNWL-SA-4871(Rev.)) TRITIUM INVENTORY CONSIDERATIONS IN LITHIUM BLANKETS. Wittenberg, L. J.; Vogelsang, W. F.; Johnson, A. B. Jr. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1974. 14p. (CONF-740402-45). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

A separation technique based upon the reversible formation of yttrium tritide for the extraction of tritium from a liquid lithium blanket was applied to a 5000 MW(th) Fusion Reactor Design. Based upon extrapolated thermodynamic parameters, the technique reduced the tritium concentration to the low level required, 5 ppM (wt), but because of the large lithium inventory nearly 8.5 kg remained in the reactor system. Experimental information of the kinetics and thermodynamics in the temperature range of interest are needed to complete the study. An isotopic dilution technique with deuterium was shown to be useful to reduce the tritium inventory by a factor of 1000. Preliminary considerations of an isotopic separation technique for D_2 and DT indicated that a cryo-

genic distillation system gave good separation at the required flow with a small tritium inventory. (auth)

15176 (BNWL-SA-4988) SOME SAFETY CONSIDERATIONS OF HYBRID REACTORS IN COMPARISON WITH FISSION AND FUSION REACTORS. Wolkenhauer, W. C.; Stewart, C. W.; Werner, R. W.; Lee, J. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1974. 13p. (CONF-740402-44). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

A preliminary study of the relative radioactive inventories of fission, hybrid, and fusion reactors is reported along with an analysis of the reactivity insertion and loss of coolant accidents as they relate to hybrid reactors. The results of these studies have allowed for a preliminary assessment of the relative safety of hybrid reactors in comparison with fission and fusion reactors. In this study, there was found to exist a whole spectrum of possible hybrid designs whose relative radioactive material inventory decreases with reactor power density. A substantial margin exists against achieving criticality in a reactivity insertion accident and melting the fuel in a loss of coolant accident. In addition, it appears that tritium may be the controlling inventory for the hybrid reactor. (auth)

15177 (CONF-740609-3) RECOVERY OF TRITIUM FROM FUSION REACTORS: RECENT RESULTS. Watson, J. S.; Cherdack, R.; Forrester, R. C. (Oak Ridge National Lab., Tenn. (USA)). 1974. 12p. Dep. NTIS $4.00.

From 77th national meeting on the American Institute of Chemical Engineers; Pittsburgh, Pennsylvania, USA (2 Jun 1974).

A conceptual design is proposed for a tokamak burning experiment which relies upon no unusually difficult process steps. The amount of developmental work required to demonstrate the system should be reasonably small. Perhaps the unique feature of the design is the use of multiple parallel process modules attached to each liner vacuum pump. This multiple process concept adds flexibility to the system since some limited experiments could be continued during repair of the process module(s). In addition, it limits the consequence (by a factor of 8) of some of the conceivable tritium release accidents. The maximum conceivable release would involve the storage tanks, even though these tanks are licensed for travel on highways and appear to be far less likely to fail in their protected positions in storage modules. The complete safety analysis of this system will not be prepared until more detailed designs are available, but efforts have been made to anticipate possible modes of failure and to produce designs which would keep the consequences of these failures acceptable. (auth)

15178 (GA-A-12959) SCALING OF CIRCULAR AND NONCIRCULAR CROSS SECTION TOKAMAK POWER REACTORS. Jensen, T. H.; Baker, C. C.; Hopkins, G. R. (General Atomic Co., San Diego, Calif. (USA)). 1 Apr 1974. Contract AT(04-3)-167. 23p. (CONF-740402-46). Dep. NTIS $4.25.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

A study of the scaling of noncircular and circular cross section Tokamak reactors was carried out using simple analytical expressions. The primary objective of the study is to find an acceptable set of power reactors parameters which satisfy a number of different constraints. The specification of the appropriate constraints is complex because there are more constraints than unknowns in the problem. The method employed here is to choose a set of constraints which are believed to be the most restrictive. The desired parameters are then calculated and a check is made to determine if the unused constraints are satisfied. If not, the process is repeated until an acceptable set is obtained. (auth)

15179 (IPP-4/112) TRITIUM ECONOMY AND TRITIUM SAFETY OF FUSION POWER PLANTS. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jan 1974. 59p. Dep. NTIS (US Sales Only) $6.00.

The inter-relationships between the quantities governing questions of economy are outlined. The application of diffusion forced tritium removal methods is discussed. Two different solutions are investigated: tritium extraction from the secondary circuit and inside a bypass of the main string of the primary loop of a fusion reactor power conversion system. Six possible types of thermal power cycles are investigated. Special effort was devoted to the bypass solution, which offers some advantages in the way of system independence, flexibility, and safety. A method of optimizing such a device is described. In order to demonstrate this procedure, a number of numerical calculations were performed, the results of which are presented in a series of tables. (auth)

15180 (JAERI-M-5431) IONIZATION RATES IN TOKAMAK PLASMAS. Fujisawa, N.; Funahashi, A.; Kasai, S.; Sugawara, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1973. 16p. (In Japanese). INIS.

The ionization rates of tokamak plasmas are numerically calculated, in measuring the particle confinement time in plasmas. The population of excited levels for hydrogen atoms, ionization rates and photon numbers of H_α and H_β lines are obtained by applying a collisional–radiative model to the tokamak plasmas. These results are compared with those obtained in the U.S.S.R. and U.S.A. The report may provide useful data in measuring the particle confinement time of JFT-2. (auth)

15181 (KHFTI-72-9, pp 3-5) DEVELOPMENT OF VACUUM PRODUCTION BY THE CONDENSATION TECHNIQUE AT THE KHFTI, An Ukrainian SSR. Grishin, S. F. 1971. (In Russian).

The physical and technological features of a vacuum pump, based on the phenomenon of condensation of the basic components of air, are described. The advantages of the method over other methods of obtaining a vacuum are discussed. With a pump of this type cooled by liquid oxygen or helium it is possible to obtain a vacuum of 10^{-9} to 10^{-11} torr in volumes of several hundred liters. The pump has been widely used with the magnetic plasma trap VGL-2, and fields of its use are expanding. (tr-auth)

15182 (LA-5474-P(Supp. 1)) SUPPLEMENT TO PROPOSAL FOR THE CONSTRUCTION OF A SCYLLA IV-P CONFINEMENT STUDIES THETA PINCH. Ellis, W. R.; Freidberg, J. P.; Quinn, W. E. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 10p. Dep. NTIS $4.00.

A 2-MJ, 5-meter-long linear theta-pinch experimental facility, called Scylla IV-P, has been proposed to obtain important physical and technological data in support of the LASL high-beta confinement program. The original proposal is contained in Los Alamos Scientific Laboratory report LA-5474-P (Dec. 1973). This report is intended to supplement LA-5474-P. It contains additional information on the numerical values of the m = 1 and m = 2 growth rates expected in Scylla IV-P, and has expanded, updated timetables for the machine design, construction, and operational schedules. (auth)

15183 (LA-5603-MS) BURN CHARACTERISTICS OF MARGINAL DEUTERIUM–TRITIUM MICROSPHERES. Henderson, D. B. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Existing studies of the thermonuclear burn of *DT* microspheres have assumed complete Maxwellian distributions in the reactivity $\langle \sigma v \rangle$. Under marginal conditions, $\rho R < 10^{-2}$, one finds long mean-free-paths for ions in the tail of the distribution may quench the burn. This missing factor appears to explain the lack of success in laser-fusion experiments conducted to date. (auth)

15184 (LA-UR-74-870) TECHNOLOGICAL ASSESSMENT OF THE REFERENCE THETA-PINCH REACTOR (RTPR). Krakowski, R. A.; Thomassen, K. I.; Coultas, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 40p. (CONF-740630-3). Dep. NTIS $5.00.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

Recently completed engineering design of a Reference Theta-Pinch Reactor (RTPR) allows an assessment of major technological and environmental implications. This conceptual design in some instances is based on extrapolations of contemporary plasma physics, material science, energy storage technology, and tritium chemistry. The major technological uncertainties and problem areas associated with the pulsed, theta-pinch reactor concept are the requirements of efficient energy storage/transfer and an electrically insulating first wall. The high aspect ratio (major radius = 56.0 m, minor radius = 0.5 m) and the pulsed operation of the RTPR greatly simplify fabrication, maintenance, coolant pumping, fueling, and ash-removal requirements. Uncertainties in the areas of plasma physics, tritium handling, neutronics, power conversion, and environmental effects are also enumerated and elucidated when possible. (auth)

15185 (LA-UR-74-883) FUSION REACTOR NUCLEAR ANALYSIS METHODS AND APPLICATIONS. Dudziak, D. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 24p. (CONF-740630-2). Dep. NTIS $4.25.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

Extensive neutronic and photonic analyses have been performed for conceptual theta-pinch fusion reactors. Characteristics investigated include tritium breeding, neutron/gamma-ray energy deposition, transmutation, primary radiation damage effects, biological shielding, radioactivity, and afterheat. In the process of perform-

ing these analyses a nucleonics method has evolved into what is known as the Los Alamos CTR Nuclear Analysis System. Although such a system is being continually improved as the nuclear analysis technology advances, its present capabilities are described in detail. Included in the system are data preparation, neutron and gamma-ray transport (discrete-ordinates and Monte Carlo), and postprocessing codes to determine reaction rates of interest for fusion reactors. A self-consistent set of codes to process multigroup neutron and gamma-ray interaction cross sections, gamma-ray production matrices, and kerma factors from pointwise ENDF data is described. Discrete-ordinates calculations use the one-dimensional DTF-IV code, and a postprocessor code (TR3) has been developed specifically for fusion reactor analysis. Nucleonics studies of laser-fusion reactors have used the same nuclear analysis system, but they may require additional time-dependent capabilities for analysis of shock waves during and after nuclear energy deposition. Specific examples of the system's application to a toroidal Reference Theta-Pinch Reactor design and a Linear Theta-Pinch Reactor hybrid are discussed. Lastly, some future development needs in CTR nuclear analysis are summarized. (auth)

15186 (LBL-2469) MIXED SPECIES IN INTENSE NEUTRAL BEAMS. Berkner, K. H.; Pyle, R. V.; Stearns, J. W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 14p. (CONF-740402-39). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Present high-current ion sources for neutral injection experiments accelerate a mixture of atomic and molecular hydrogen species that are converted into neutral particles with different energies and neutralization efficiencies. Beam composition can have important effects on injection system efficiency, vacuum system design, and first-wall loading. Measured and inferred neutralization efficiencies for the LBL high-current sources are given. (auth)

15187 (MATT-1044) EXACT EQUILIBRIA OF AXISYMMETRIC MAGNETIC CONFIGURATIONS. Mazzucato, E. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Apr 1974. Contract AT(11-1)-3073. 14p. Dep. NTIS $4.00.

Whether for easing the restrictions imposed by equilibrium and stability or for improving the plasma purity with the use of magnetic divertors, many devices of the next generation of tokamaks will have a shaped minor cross section. A class of solutions of the ideal MHD equilibrium equations of an axisymmetric magnetic configuration is derived. These solutions, besides including magnetic configurations with a large variety of cross sections and nonuniform current distributions, are exact solutions obtained without making any assumptions on the value of the aspect ratio. (auth)

15188 (ORNL-TM-4617) FUSION DYNAMICS OF LOSSY REACTOR SYSTEMS. McNally, J. R. Jr.; Clarke, J. F.; Sharp, R. D.; Fowler, R. H. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 31p. Dep. NTIS $4.75.

Nuclear fusion reactivity calculations are reported for zero-dimensional, magnetically confined, lossy reactor systems after the methodology of Etzweiler, Clarke and Fowler. These systems are radiation damped, dissipative-trapped-particle-loss-mode dominated DT fueled reactor of 5 m minor radius, 15 m major radius with $B_0 = 43$ kG, $I_T = 8.9$ MA, and $Z_{eff} \simeq 1$. The plasma is assumed to be formed by ohmic heating at $t = 0$ as a delta function in temperature ($T_{i0} = T_{e0} = 1.5$ keV) and density ($n_{e0} = 2\,n_{D0} = 2\,n_{T0} = 6.5 \times 10^{19}$ m^{-3} $\bar{n}_0 \ll 10^{12}$ m^{-3} to reduce charge exchange losses). Injection of a mixed energetic neutral beam of D^0 and T^0 at $E_0 = 300$ keV heats the plasma to ignition at 5 keV in about 3 sec. A temperature runaway and power excursion occur as a result of the positive reactivity during the next 2 sec, following which the increasingly severe dissipative trapped ion losses ($L_{Ti} = 1/\tau_{Ti} \propto T_e^{3.5}$) lead to a plasma "blow-out" phenomenon at $T_e \simeq 18$ keV. An analytic treatment of the blow-out process is given and it is identified with the use of too high an injection energy [$E_0 \geq \frac{3}{2}\,\gamma\,(T_i + T_e)$, where $\gamma \sim 2$ accounts for both energy conduction and particle diffusion losses due to the trapped ion mode]. The effect of reducing the fuel injection energy below the instability value is to permit steady state operation at high Q_η ($= P_{out}/P_{in}$). An additional advantage that accrues to operation at reduced fuel injection energies is the opportunity to tailor the radial density gradient which defines the severity of the trapped ion losses. According to Kadomtsev and Pogutse the dissipative trapped particle diffusion coefficient is directly proportional to the square of the density gradient. The effect of 10-fold reduction of the density gradient from a parabolic profile is to permit steady state operation even at $E_0 = 300$ keV injection energy but with a quite small Q value of only 0.85. Pulsed mode operation at 300 keV injection energy, even with the full trapped ion losses, allows 8 sec long pulses with an average Q of about 6 and burn-up of 2.3%. A steady state tokamak can operate, in principle, at $E_0^* = 25$ keV after ignition with $E_0 = 300$ keV neutrals with a Q of 22 and a fuel replacement time of 4.4 sec. Burn-up is 4.8%. This steady state tokamak assumes full trapped ion losses and presumes fuel feed via successive charge exchange events deep into the reacting plasma (charge exchange losses will reduce the effective Q and the burn-up). The temperature perturbation of such a steady state reactor ($E_0^* = 25$ keV, $P_{INJ} = 56$ kW/m^3, $P_{out} \approx 1200$ kW/m^3) leads to a negative temperature coefficient; source perturbations give a positive density coefficient which must be carefully controlled to prevent excessive wall loading, etc.; magnetic field perturbations give a positive field coefficient which would permit positive feedback control on the reactivity with a time constant comparable to the fuel replacement time of 4.4 sec; and density gradient perturbations from a parabolic density profile give a negative density gradient coefficient. (auth)

15189 (RLO-2221-T-7-16) VACUUM AND SURFACE STUDIES CONCERNING PLASMA ENVIRONMENTS. Final report, June 1972–September 15, 1973. Donaldson, E. E. (Washington State Univ., Pullman (USA). Dept. of Physics). 1973. Contract AT(45-1)-2221. 7p. Dep. NTIS $4.00.

A brief discussion of work during this contract period is given. The topics deal primarily with hydrogen interaction with a niobium surface, noble gas trapping by stainless steel 304, and ion trapping studies. A list of published papers is included. (MOW)

15190 (SLA-73-7070) HELIUM AND HYDROGEN ISOTOPE DEPTH PROFILES AND MIGRATION IN CTR MATERIALS. Blewer, R. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 20p. (CONF-740402-40). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

In a series of studies, the effect of helium injection on the near surface region of metals has been investigated. A proton backscattering technique was applied to the problem of determining the depth distribution of helium atoms implanted at various energies into metals and the changes which occur in those distributions at temperatures up to 600°C. ^{4}He distributions implanted at 50 keV (and several other energies) have been observed in Nb, V, stainless steel, Ti, Cu and erbium. Projected range measurements agree with theoretical calculations within ±3% (100 Å) for Cu and Ti but disagree from 8% to 20% for V, Nb and Er. In all cases, the "as implanted" profiles are symmetric at room temperature and exhibit no evidence for gas atom migration to the surface through residual damage produced by the implantation. Changes in the implanted profiles have been observed in Ti and Cu after annealing in situ up to temperatures of 600°C. Helium release begins in Ti at ~400°C (.346 T_m) and in Cu at ~200°C (.349 T_m) suggesting that vacancy mobility is operative in the onset of subsurface helium bubble formation. The temperature dependence was found to be closer to linear than exponential suggesting that long-range diffusive motion of the helium atoms was not involved in the release mechanism. Rather, the sequential changes in the depth profiles with increasing temperature suggest that essentially all of the helium which is released comes directly from the implant layer in both metals as a result of the formation and rupture of bubbles at the end of range. An SEM study supports this conclusion. At 600°C the surface oxide layer abruptly increased in thickness, passing the depth of the implanted layer and evidently inhibiting further helium release. The details of the surface spallation also differ for Ti and Cu, apparently because of the vigorous oxidation in Ti, even under vacuum anneal conditions. (auth)

15191 (UCID-16530) COMPUTATIONAL STUDIES OF THE TWO-COMPONENT TOROIDAL FUSION TEST REACTOR. Killeen, J.; Johnson, T. H.; Mirin, A. A.; Rensink, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1974. Contract W-7405-eng-48. 171p. Dep. NTIS $11.75.

An extensive study of plasma behavior in the two-component torus is made using a variety of theoretical and computational models. Using a two-dimensional multi-species Fokker–Planck code the factor Q (the ratio of thermonuclear energy to input energy) is computed for a variety of reaction conditions. In these calculations the DT mixture, the injection energy, and electron and tritium temperatures and the effects of impurities are varied. With the Fokker–Planck code, where the time-dependent distributions functions of the ions are functions of energy and pitch angle, the effects of energy clamping, fast compression, and decompression on the slowing down and energy multiplication of the injected beam are studied. The equilibrium of the two-component plasma with its confining magnetic field is studied with a two-

dimensional equilibrium code. The target plasma is represented by a pressure, which is a function of ψ. The fast ions are simulated by superparticles whose guiding-center motion is computed and which contribute to the toroidal current. With this code co- and counter-injection of the beam are studied, varying the injection profile, energy, and current. The aspect ratio, toroidal field, and plasma current are also varied. (auth)

15192 (UCRL-50002-73) CONTROLLED THERMONUCLEAR RESEARCH. Annual Report, July 1, 1972–June 30, 1973. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1973. Contract W-7405-eng-48. 129p. Dep. NTIS $5.45.

The Controlled Thermonuclear Research (CTR) program at Lawrence Livermore Laboratory (LLL) during FY 1973 has resulted in several significant encouraging developments which have re-focused the mirror program. These include demonstrations in 2XII, a pulsed, compression-heating experiment of quiescent hot, dense plasma which decays at a rate which is nearly classical and which can be theoretically explained. High-current (10 A, 20 keV) neutral beam injection was initiated with encouraging results. These observations and the rapid progress of the high-current beam development program have resulted in plans to re-build 2XII for very high-current beam heating experiments. In BBII, a dc experiment with a superconducting magnet, extremely good vacuum conditions have allowed charge-exchange effects to be greatly reduced, and classical decay rates are observed. Investigation of target plasma possibilities for enhancing buildup has begun. The Astron program was terminated in February 1973 in order to direct more efforts to other experiments. E-layers with about half the strength required for field reversal were achieved. The Superconducting Levitron was also discontinued at the end of FY 1973 for similar reasons. During the year, dense high-β hot electron plasma confinement was achieved and progress was made toward heating of ions by this electron plasma. Neutral beam development at Lawrence Berkeley Laboratory (LBL) has progressed rapidly. The 10-A 20-key pulsed source was successfully used on 2XII and work was started to extend this source capability to 50 A. A near-dc (10-sec pulse length) source is being developed to provide 1 A at 3 keV for injection into BBII. At LLL, a 200-A pulsed source development was started to provide for future 2XII-B requirements as well as long-range needs. A new direct energy conversion facility has been nearly completed which is capable of guiding protons of 1.5 keV from a 30-kG region through an expander coil to 100 G at the collector end. This facility will allow testing of most of the critical physics features of direct converters. A more practical Nb_3Sn tape superconductor has been developed using an aluminum stabilizer and nickel reinforcing. Other technology efforts have included completion of a design study of a 200-MWe mirror reactor, along with detailed studies of reactor components such as blanket design, direct converter, superconducting coils and injectors. Preliminary parameter studies were started for a Fusion Engineering Test Facility (FERF). (auth)

15193 (UCRL-75354) TRITIUM IN THE FUSION ENGINEERING RESEARCH FACILITY. Hickman, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 May 1974. 30p. (CONF-740630-1). Dep. NTIS $4.50.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

Study of a major facility to support technological development of fusion power is in progress. The machine would use magnetic mirrors to confine a steady-state D-T plasma producing 10^{14} MeV neutron/cm^2 · s. Electric power consumption would be 200 MW to produce 5 MW of thermonuclear power. Neutral beam injection will maintain the plasma. Tritium problems fall principally into two categories: confinement and recycling. Confinement of tritium is essential. All parts of the facility containing significant tritium inventories will be totally enclosed. The air or inert gas surrounding major pieces of equipment will be continuously processed to keep its tritium concentration at low levels. Special designs are used to minimize permeation of implanted tritium into the first wall coolant. (auth)

15194 (UCRL-75367) LASER SYSTEMS FOR LASER FUSION. Buntzen, R. R.; Rhodes, C. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Apr 1974. 16p. (CONF-740402-41). Dep. NTIS $4.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

Successful development of a laser fusion central power station will require unique lasers having specialized characteristics which are not well satisfied by any known laser materials. It is important at this early time to begin development of a format by which new laser media and the corresponding systems concepts can be evaluated. A "reference" laser fusion power plant design is adopted to estimate required laser system efficiencies. In connection with this design, a hypothetical oxygen auroral line laser is used as a model to delineate the many parameters effecting laser system performance. (auth)

15195 (UCRL-75368) PRELIMINARY DESIGN OF A SUPPRESSED-ABLATION, LASER-INDUCED FUSION REACTOR. Hovingh, J.; Maniscalco, J.; Peterson, M.; Werner, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 May 1973. 41p. (CONF-740402-42). Dep. NTIS $5.25.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

A laser-induced fusion reactor that features low-pressure pulses on the reactor first wall is described. This reactor has less stringent structural requirements, reduced vacuum-pumping power requirements, and higher pulse repetition rates than the reactors that operate with very-high, transient first-wall pressures. For a 25 MW_e reference reactor with a 2.2 m first-wall radius, the maximum first-wall pressure and temperature are 0.09 bar and 1370°K, respectively, based on a 10 Hz repetition rate. The vacuum pumping power requires only about 0.5% of the reactor output. A 1-m-thick, Li-5% Nb blanket produces a tritium breeding ratio of 1.45 and a 14 MeV neutron energy amplification of 1.1. A depleted uranium–lithium blanket is described that will have a tritium breeding ratio of 1.1 and a 14-MeV neutron energy amplification of almost 13. (auth)

15196 (UCRL-75691) PROSPECTS FOR LASER FUSION. Nuckolls, J. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 May 1974. 6p. (CONF-740617-3). Dep. NTIS $4.00.

From eighth international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

Four areas are summarized: Critical problems in laser driven implosions; experimental results and comparison with computer calculations; laser requirements for breakeven, net energy production, and power plants; and estimated time scales. (auth)

15197 (WASH-1290) FUSION POWER BY MAGNETIC CONFINEMENT. (USAEC Division of Controlled Thermonuclear Research, Washington, D.C.). Feb 1974. 104p. Dep. NTIS $8.25.

The overall fusion program to develop a working fusion reactor using low-density closed systems, high-density systems, and open systems is outlined. The present and near-term emphasis among these programs is and will be about 60% tokamaks, 20% high density, and 20% mirrors. The areas of research to be considered for future work are outlined. Items concerning funding and the overall program are discussed. (MOW)

15198 (WASH-1310) DCTR POWER SUPPLY AND ENERGY STORAGE REVIEW MEETING, GERMANTOWN, MARYLAND, MARCH 5–7, 1974. Beard, D. S. (USAEC Division of Controlled Thermonuclear Research, Washington, D. C.). 1974. 297p. (CONF-740335-). Dep. NTIS $7.60.

The objective of this meeting was to discuss present and future needs in the power supply and energy storage area and to examine the various approaches and alternatives to meet these needs. The following topics are discussed: (1) existing capabilities and projected needs, (2) possible approaches, (3) inductive systems, (4) MHD systems, (5) switching, and (6) capacitive systems. (MOW)

15199 LASER-INDUCED THERMONUCLEAR MICRO EXPLOSIONS USING FISSIONABLE TRIGGERS. Seifritz, W.; Ligou, J. (Swiss Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). Trans. Amer. Nucl. Soc.; 18: 18-19(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15200 BEHAVIOR OF HIGHLY COMPRESSED FISSILE SPHERES. Krumbein, A. D. (Soreq Nuclear Research Centre, Yavne, Israel). Trans. Amer. Nucl. Soc.; 18: 19-20(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15201 SYNCHROTRON RADIATION FROM FUSION REACTOR PLASMAS. Carlson, G. A. (Lawrence Livermore Lab., CA). Trans. Amer. Nucl. Soc.; 18: 20(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15202 COMPARATIVE STUDY OF NUCLEAR HEATING IN FUSION REACTOR BLANKETS. Abdou, M. A.; Conn, R. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 18: 22-23(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15203 SENSITIVITY OF NEUTRON HEATING IN FUSION REACTOR BLANKETS TO NUCLEAR DATA. Abdou, M. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 18: 23-25(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15204 MONTE CARLO CALCULATIONS FOR A FUSION REACTOR BLANKET AND SHIELD. El-Guebaly, L. A.; Maynard, C. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 18: 25(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15205 EFFECT OF RESONANCE SELF-SHIELDING IN NIOBIUM STRUCTURES ON TRITIUM BREEDING IN CTR BLANKETS. Gerstl, S. A. W.; Henryson, H. II. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 25-27(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15206 APPLICATION OF VARIATIONAL METHODS TO FUSION REACTOR BLANKET STUDIES. Cheng, E. T.; Conn, R. W. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 18: 27-28(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15207 EFFECT OF TEMPERATURE ON FIRST-WALL EROSION BY RADIATION BLISTERING. Kaminsky, M.; Das, S. K. (Argonne National Lab., IL). Nucl. Technol.; 22: No. 3, 373-378(Jun 1974).

The effect of target temperature on blister formation and the erosion rates associated with helium blistering was investigated for vanadium and Type 304 stainless steel. The irradiation temperature was varied from room temperature to 900°C for vanadium targets and was varied from room temperature to 550°C for stainless-steel targets. The vanadium and stainless-steel targets were bombarded with helium ions of 0.5 MeV and of 0.1 and 0.5 MeV, respectively. The total dose was varied from 0.1 C/cm^2 to 1.0 C/cm^2 (6.24 × 10^{18} ions/cm^2). The results show that the degree of blistering and the erosion rates associated with blister rupture and exfoliation are strongly temperature dependent. For example, for stainless-steel samples the maximum erosion rates were observed at an irradiation temperature of ~450°C, and the erosion rate was found to be smaller at the higher temperature of ~550°C. For vanadium samples, the maximum erosion was observed to occur at higher temperatures than for the stainless-steel cases. (auth)

15208 EXPLOSIVE ELECTRON EMISSION AND THE CHARACTERISTICS OF HIGH-CURRENT ELECTRON FLOW. Parker, R. K. Albuquerque, NM; Univ. of New Mexico (1973). 299p. University Microfilms Order No. 74-11,800.

Thesis (Ph.D.).

The class of high-current, cold-cathode diode distinguished by non-selfconvergent electron flow was studied to (1) define the operative electron emission mechanisms, (2) to determine the dominant plasma phenomena within the interelectrode volume, (3) to classify the modes of electron flow, and (4) to verify the Friedlander beam convergence criterion. A basis for unfolding these elements of observed diode behavior was developed from a detailed analysis of the time dependent, voltage–current characteristics of the diode. Since the electron flow throughout the predominant portion of the accelerating pulse was space-charge limited, separation of the interrelated diode phenomena was facilitated by representing the voltage–current data in terms of the diode perveance. To confirm certain of the assumptions fundamental to the interpretation of the perveance data, streak photography of plasma luminosity motion within the diode was combined with measurements of the time-integrated as well as time-dependent current density distribution at the anode plane. When correlated with the theory of high-voltage vacuum breakdown formulated by Dyke, Charbonnier, Mesyats, and others, the results of this diode study provide a complete and self-consistent description of the dominant processes acting within a high-current, cold-cathode diode. Within this model, six distinct phases of diode response can be identified. If a high-current, relativistic electron accelerator is to generate the high-power electron beam for which it was designed, the diode must evolve through at least the first four of the six phases. In sequential order, these phases are as follows: (1) stable field emission from microscopic, whisker-like cathode projections, (2) transition to cathode-initiated vacuum breakdown, (3) whisker explosion and the formation of a cathode plasma sheath, (4) space-charge-limited emission from the expanding plasma sheath, (5) transition to self-convergent flow, and (6) development of a highly convergent electron flow. (Diss. Abstr. Int., B)

15209 APPLICATION OF LASER FUSION TO THE PRODUCTION OF FISSILE MATERIALS. Horoshko, R. N. (Univ. of Rochester, NY); Zmora, H.; Hurwitz, H. Ann. Nucl. Sci. Eng.; 1: No. 3, 223-232(Mar 1974).

Calculations are made for the amount of ^{239}Pu produced and the number of fast fissions occurring per 14-MeV neutron in a medium containing various concentrations of ^{238}U, ^{239}Pu, ^{16}O, and ^{23}Na. Neutrons are assumed to be produced by a laser induced D + T fusion reaction and to interact with a blanket containing fertile materials where plutonium breeding occurs. Calculations show that in pure ^{238}U the neutron multiplication factor is 4.6 and that 1.08 fast fissions occur per each D + T reaction. Assuming a neutron production rate of 3 × 10^{19} sec at E_n = 14 MeV and allowing for ^{23}Na cooling of the ^{238}U blanket, the thermal energy generated is nearly 1000 MW, while the thermal value of the produced ^{239}Pu is 4 times as large. Values are somewhat lower in cases where UO_2 is used in the blanket. Buildup of ^{233}Pu in the blanket is considered and is found to have the effect of strongly increasing both the net ^{239}Pu production and the thermal power generated. Possibilities of using ^{232}Th in the blanket and the D + D fusion reaction are also discussed and are found to be energetically inferior. (auth)

15210 PLASMA PRODUCTION BY SCREW-PINCH. Hayase, K.; Toi, K.; Okuda, T. (Nagoya Univ., Japan). Denki Gakkai Ronbunshi, A; 93: No. 4, 127-132(Apr 1973). (In Japanese).

Plasma production by screw-pinch, and results of the measurement of electron density and temperature are described. A z current circuit was installed to the previously established theta pinch device. Measurement was made with a high speed camera, 90° laser scattering, a Mach–Zehnder type interferometer, and a magnetic loop. The results are as follows: the production of uniform plasma with good reproducibility, and effective compression require preliminary ionization; nonuniformity of the discharge is due to the nonuniformity of break down of insulation of gas; addition of inverse bias magnetic field does not bring about good results for stability; and the electron density depends slightly on the amount of z current. Heating of the screw pinch seems to be mostly due to the theta pinch. The compression process can be explained by the snowplow model. Heating by the z pinch can be neglected. The z pinch contributes mainly to the stability. Distribution of the z current was varied by changing ignition time of the discharge. Even in the case of sharp distribution, its base extended more widely than the plasma radius. By making the time interval between the theta pinch and the z pinch Izθ small, the distribution spreads widely, but the distribution within the plasma becomes uniform. Low density plasma outside the center plasma was suggested from the current flowing outside of the plasma pillar. (JA)

15211 BEAM-PLASMA HIGH-INTENSITY ION SOURCE. Demirkhanov, R. A.; Kursanov, Yu. V.; Skripal, L. P. (Physical-Technical Inst., Sukhumi, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 684-685(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1079-1081(May 1973).

A high-intensity ion source is described which uses a beam–plasma discharge to obtain directed fluxes of hydrogen ions with an intensity 30 A and an ion energy of several kiloelectron volts. The acceleration of the ions occurs in an ambipolar electric field along an inhomogeneous magnetic field with a negative gradient. The critical parameters that determine the intensity and energy of the directed ion flux are the power of the injected electron beam, the discharge length, the pressure of the gas in the discharge, the degree of inhomogeneity of the magnetic field, and the ratio between the longitudinal and transverse velocities of the beam electrons. (auth)

15212 PRESENT STATUS AND FUTURE OF NUCLEAR FUSION REACTOR TECHNOLOGY. Nippon Genshiryoku Gakkai-shi; 15: No. 11, 712-758(Nov 1973). (In Japanese).

Progress on nuclear fusion reactor technology is reported. The first section discusses the necessity of fusion reactors. Demand for energy and the present energy resources such as oil, electricity, and fissile materials, the resources for nuclear fusion reactors, diversification of the energy resources and their efficient use, safety and environment of fusion reactors, and the necessity of independent development in Japan, are discussed. The characteristic features of low-beta torus, high-beta torus, open-type magnetic vessels, and laser pellet types are introduced. The tokamak-type reactor is discussed in detail. The third section concerns reactor cores, core plasma, core technology, and superconductive coils. The fourth section is devoted to the nuclear properties of material to be used, heat removal, and the tritium

cycle. The safety and economy of nuclear fusion plants are also discussed. The fifth section describes the material for fusion reactors. Irradiation effects, coexistence of the blanket environment, and the materials for superconducting magnets are discussed. Selection of materials and the technical problems concerning the construction of reactors are also discussed. The discussion in the final section concerns various technical problems for the development of fusion reactors. (JA)

15213 EFFECT OF ELEMENT DISTRIBUTION IN A CAPACITOR BANK ON THE CURRENT PULSE IN A PULSED PLASMA INJECTOR. Belan, N. V.; Mashtylev, N. A.; Panachevnyi, B. I.; Shushlyapin, L. V. (Kharkov Aviation Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 749-751(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1179-1183(Jun 1973).

A system of equations is derived for the operation of a pulsed plasma injector whose capacitor bank consists of distributed elements. The amplitude and length of the current pulse in the injector are analyzed as functions of the element distribution in the bank. (auth)

15214 CANADA'S APPROACH TO FUSION AS AN ALTERNATIVE SOURCE OF ENERGY. Carruthers, J. Sci. Forum; 7: No. 2, 6-9(Apr 1974).

The recent interest shown by Atomic Energy of Canada Ltd. in laser-induced deuterium–tritium fusion does not involve the direct conversion of fusion energy to electricity but rather follows up the potential of employing this reaction to generate neutrons for enriching uranium fuel with ^{233}U prepared from ^{232}Th. The enriched fuel can then be burned in CANDU fission reactors. This fission–fusion symbiosis approach would initially consist of separate fusion plants which would produce enriched uranium from a thorium-fuel blanket around the reactor vessel, but eventually AECL scientists foresee the fusion neutron source built into the heart of a fission reactor. This application of fusion should be more readily attainable at considerably lower cost than the direct conversion schemes for fusion presently being pursued by nations advanced in this technology. (CA)

15215 MAGNETIC FIELD IN A BASEBALL TRAP. Sveshnikov, A. G.; Telegin, V. I.; Semashko, N. N. (Moscow State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 836-838(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1313-1316(Jun 1973).

Numerical methods are used to find the characteristics of the magnetic field in a trap with a baseball winding. The coordinates of the lines of force, the mirror ratios along the symmetry axes, and the volumes bounded by the B = const surfaces are found for various values of the basic geometric parameters. (auth)

15216 POWER FROM FUSION. Jha, S. S. (Tata Inst. of Fundamental Research, Bombay). Sci. Today (Bombay); 8: No. 1, 13-17(Jul 1973).

Power generation by controlled nuclear fusion is considered at present as an answer to the increasing power demands of the future. The basic problems involved in the generation of fusion power are to generate a high-temperature plasma, and to sustain the plasma for a considerable time. Some plasma devices now in use for generating and confining high-temperature plasmas including the laser-heated fusion device are briefly described. The need for further improvement in technology is pointed out for realizing the fusion reactor as a practical and economical power device. (INIS)

15217 TECHNICAL PROBLEMS IN CONTROLLED FUSION RESEARCH. Trocheris, M. G. (CEN, Fontenay-aux-Roses, France). Sci. Tech. (Paris); No. 5, 25-31(15 Jun 1973). (In French).

Technical problems encountered in controlled fusion research are considered. Particular problems studied by the CEA in this field are presented as examples. These examples concern three different disciplines: pulsed electrical energy sources; ultrahigh vacuum techniques; and radiofrequency waves. Two rotating pulse generators developed in collaboration with the Compagnie Electro-Mecanique are briefly described. A summary is then given of progress made in the field of ultrahigh vacuum using titanium pumping. Electromagnetic wave technology plays an important part in controlled fusion research. Several examples of corresponding developments are presented. (FR)

15218 FUSION REACTOR, A PROMISING SOURCE OF ENERGY. Stubbe, E. J. (Societe de Traction et d'Electricite, Brussels). Ingenieursblad; 43: No. 13-14, 407-416(In Dutch).

Starting with some considerations about the present energy crisis and a few criteria for new future energy sources, the fundamentals of thermonuclear fusion reactions are discussed. The main parameters and characteristics of some important test configurations are described together with the advantages of each system. Next, the principles of a fusion reactor and the main technological problems are described. Some important aspects of a fusion energy source are mentioned. A planned timetable of the fusion technology in America and Europe is presented. (auth)

15219 NUCLEAR FUSION. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 367-420 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

The problem of meeting the energy requirements in the period following the nuclear fission stage, finds its solution in the utilization of controlled thermonuclear reactions. Consequently, the general properties of the plasma, as well as its production methods are presented. Among the different problems of a particular interest in the plasma physics at present, special attention is paid to controlled thermonuclear reactions, the confinement of the hot plasma, and the use of the plasma produced by lasers. (INIS)

15220 ATHERMAL NEUTRONS AND IONS IN A FUSION PLASMA. Brueckner, K. A.; Brysk, H.; Janda, R. S. (KMS Fusion Incorporated, Ann Arbor, MI). J. Plasma Phys.; 11: No. 3, 403-409(Jun 1974).

For a laser-driven fusion plasma dense enough to absorb the fusion particles, the slowing down of the reaction products and of their cascade of recoils is calculated (treating discrete energy loss in a collision correctly). The occurrence of reactions between the slowing-down particles and ambient ions is also calculated. The products of these reactions are in turn followed, through as many iterations as necessary. Illustrations are given. (auth)

Wave Phenomena

15221 (AEC-tr-7552) PRECURSOR PHENOMENON IN IONIZED SHOCK WAVES. Tejima, M.; Shirai, K. (Kyoto Univ. (Japan)). 1973. Translated from Symposium on Magnetohydrodynamics, Tokyo, Japan, 12–13 February 1970. 7p. Dep. NTIS $4.00.

Experimental and theoretical considerations were used in an attempt to explain the precursor phenomenon in terms of diffusion of electrons through the shock front. (auth)

15222 (BUM-46) EFFECTS OF TRAPPED AND UNTRAPPED PARTICLES ON AN ELECTROSTATIC WAVE PACKET. Espedal, M. S. (Bergen Univ. (Norway). Dept. of Applied Mathematics). Dec 1973. 31p. Dep. NTIS (US Sales Only) $4.75.

The propagation of an electrostatic wavepacket in a collisionless plasma is studied. A change in amplitude caused by interaction between the packet and particles propagating with velocities near to the group velocity is obtained. Modulation of the plasma in the front of the plasma caused by trapping effects is also obtained. (auth)

15223 (JINR-P9-7988) MATHEMATICAL MODELING OF EVOLUTION OF SPHERICAL SYMMETRIC PACKETS OF LANGMUIR WAVES. Bogolyubskii, I. L.; Makhan'kov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The evolution of spherical symmetric packets of Langmuir waves was investigated using the hydrodynamic approximation. Existence of stationary states to which initial packets are evolving was shown via computer. (auth)

15224 (KHFTI-72-45, pp 92-94) CHERENKOV EXCITEMENT OF LONGITUDINAL WAVES IN NONLINEAR PLASMA. Kurilko, V. I.; Tolstoluzhskii, A. P.; Fainberg, Ya. B. 1972. (In Russian).

The nonlinear theory of Cherenkov excitation of longitudinal oscillations of isotropic plasma and of quasi-conducting waves with a given distribution of the moving charge in an anisotropic plasma was discussed. (tr-auth)

15225 (LRP-79/74) PROPAGATION OF SOLITARY WAVES IN A TWO ION SPECIES PLASMA WITH FINITE ION TEMPERATURE. Tran, M. Q. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Mar 1974. 18p. Dep. NTIS (US Sales Only) $4.00.

Using a Korteweg-de Vries equation, the propagation of ion acoustic solitary waves in a two ion species plasma with $T_i \neq 0$ was studied. As the dispersion relation presents two acoustic branches with quite different phase velocities, two types of soliton can propagate: the slow one which is subsonic with respect to one ion mode and supersonic to the other, has greater amplitude and smaller width than the first one. (auth)

15226 (LRP-81/74) EFFECTS OF THE PUMP SYMMETRY ON THE PARAMETRIC EXCITATION OF TRANSVERSE AND LONGITUDINAL WAVES. Nguyen The Hung. (Ecole Polytechnique Federale, Lausanne (Switzerland)). May 1974. 10p. Dep. NTIS (US Sales Only) $4.00.

The parametric coupling of transverse and longitudinal waves in a plasma is shown to depend strongly on the structure of the pump wave. Within the fluid model, the threshold pump intensity and the maximum growth rate of the excited waves are obtained for the cases of a linearly polarized, a traveling, and a standing circularly polarized pump wave. (auth)

15227 OBSERVATION OF BERNSTEIN WAVE PROPAGATING OBLIQUELY TO THE MAGNETIC FIELD IN A STREAMING PLASMA. Idehara, T.; Takeda, M.; Ishida, Y. (Fukui Univ., Japan). Fukui Daigaku Kogakubu Kenkyu Hokoku; 21: No. 2, 89-92(Sep 1973).

Bernstein waves propagating obliquely to the magnetic field are excited by a coaxial antenna in a streaming plasma and detected by the interferometer system, which shows that the dispersion relation for the wave is consistent with the theoretical result. The other wave-like signal with shorter wavelength is observed only on the downstream of the exciting antenna and its phase velocity is approximately equal to the velocity of the plasma stream calculated from the Doppler shifts of Bernstein waves on both up, and down, streams, which may show that the signal does not propagate as the wave but floats down the plasma stream as the modulation of plasma particles. (auth)

15228 ACCESSIBILITY TO THE LOWER HYBRID RESONANCE. Artico, G.; Spigler, R. (Univ., Padua). Lett. Nuovo Cim.; 10: No. 6, 257-261(8 Jun 1974).

A cold plasma is assumed to fill the half-space $x \geq 0$, with a density gradient ∇n parallel to the x-axis and a static uniform magnetic field parallel to the z-axis. A theoretical analysis is given for the propagation of a wave that is launched from a structure which fixes the periodicity along the z axis. (MOW)

15229 EFFECT OF ELECTROSTATIC OSCILLATIONS LOWER BRANCH ON LOW FREQUENCY INSTABILITY OF INHOMOGENEOUS PLASMA. Kopetski, V. (Inst. of Physics, Prague). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 559-565(Apr 1974). (In Russian).

The effect of the main transverse mode of electrostatic high-frequency oscillations of a lower branch on stability of low-frequency grooved oscillations in inhomogeneous plasma was studied. The effect of averaged high-frequency forces is shown to result in appearance of instability at frequencies $\omega \ll \omega_{ci}$. If the wave vector component in the direction of the high-frequency magnetic field is much higher than $x = d \ln n_0/dy$, then only short-wave oscillations with $k \gtrsim k_x$ are unstable. Therefore, such a high-frequency field can stabilize long-wave ($k \sim x$) gravitation instability within a definite interval of the plasma parameters. (auth)

15230 EXPERIMENTAL OBSERVATIONS OF THE DECAY OF A HIGH-FREQUENCY WAVE IN A PLASMA. Anisimov, A. I.; Vinogradov, N. I.; D'yachenko, V. V.; Shcherbinin, O. N. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 843-844(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1321-1323(Jun 1973).

The interaction of an electromagnetic wave with a toroidal plasma is studied. The pumping wave is close to the plasma frequency and lies between the ion and electron cyclotron frequencies. When a threshold level 10^{-3} to 10^{-2} W is exceeded, oscillations are observed at a frequency displaced from the pumping wave frequency. There are also low-frequency oscillations, which seem to be ion-acoustic waves. (auth)

15231 EMISSION OF TRANSVERSE ELECTROMAGNETIC WAVES IN AN ISOTROPIC PLASMA. Diasamidze, Zh. M.; Tsintsadze, N. L. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 845-846(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1323-1325(Jun 1973).

The energy losses of a relativistic charged particle passing through an isotropic cold plasma and emitting a transverse electromagnetic wave are studied. The particle–plasma system is subject to an external high-frequency electric field $E = E_0 \sin \omega t$. The interaction time between the particle and plasma is assumed to be small in comparison with the instability time of an electron plasma in a hf field. (auth)

15232 PROPAGATION AND TRANSFORMATION OF WAVES IN INHOMOGENEOUS MAGNETOACTIVE PLASMA AT FREQUENCIES LESS THAN ELECTRON CYCLOTRON FREQUENCY. Kopetski, V. (Inst. of Physics, Prague). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 552-558(Apr 1974). (In Russian).

Propagation of high-frequency waves is considered in a weakly inhomogeneous magnetoactive plasma. The density gradient is supposed to be in the perpendicular direction to the external magnetic field. The wave frequency ω is less than electron cyclotron frequency ω_c and $k_z c/\omega > 1$ (k_z is the wave vector component in the direction of the magnetic field). It is found that within a high-density domain there occurs transformation of electrostatic waves to whistlers. (auth)

15233 STABILITY OF LONGITUDINAL WAVES PROPAGATING ACROSS A MAGNETIC FIELD. Machabeli, G. Z. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 595-597(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 938-942(May 1973).

The stability of waves of finite length propagating across a magnetic field is investigated. Expressions are obtained for the growth rate of waves whose frequencies are multiples of the electron cyclotron frequency $\omega = n\Omega_e$, and for high frequencies when $\omega \neq n\Omega_e$. (auth)

15234 DIFFRACTION OF PLASMA WAVE BY SLIT. Shal'ko, L. A. (Kharkov Pedagigical Inst.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 660-663(Apr 1974). (In Russian).

A problem of plasma wave diffraction is considered in the presence of the screen with a slit, the former being situated on the plasma–vacuum boundary. The solution is performed in the Kirchhoff approximation. An expression is obtained for a diffracted field in vacuum. (auth)

15235 THEORY OF INJECTION OF A RELATIVISTIC ELECTRON BEAM INTO A SPATIALLY RESTRICTED PLASMA. Rosinskii, S. E.; Rostomyan, E. V.; Rukhadze, A. A.; Rukhlin, V. G. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 4, 1350-1357(Apr 1974). (In Russian).

Injection of a relativistic electron beam into a plasma cylinder with a free surface was investigated. The possibility of exciting low-frequency surface waves in such systems leads to the appearance of a slowly varying high amplitude induced current in the plasma; this current considerably exceeds the beam current and significantly affects the dynamics of beam injection into the plasma. (auth)

15236 LOW FREQUENCY OSCILLATION IN A HIGHLY IONIZED, INHOMOGENEOUS MAGNETIC PLASMA. Kuroda, T.; Horikoshi, G. I.; Dodo, T.; Nishida, Y. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 3, 885-891(Sep 1973).

A measurement of low frequency self-oscillating instability in a highly ionized magnetoplasma column is reported. Radial distribution of amplitude and phase velocity of the oscillation is observed by correlation technique. Radial profile of the plasma particle density consists of two regions each of which has a different radial scale length, $n/(\partial n/\partial r)$, and it is indicated that in each region, the oscillations with different frequency are localized. The oscillations have similar properties except for the difference in the frequency. All the properties of these oscillations can be described by the theory of resistive drift instability. A rationale for the identifications of the oscillations is given. (auth)

15237 THEORY OF FLUCTUATIONS IN PLASMA. Williams, E. A. Princeton, NJ; Princeton Univ. (1973). 121p. University Microfilms Order No. 74-9733.

Thesis (Ph. D.).

The effect of longitudinal bremsstrahlung and the corresponding collisional absorption on the spectrum of fluctuations in a plasma, whose frequency is of order the plasma frequency, ω_p was investigated. This is mandatory for long wavelength ($k \ll k_D$, the Debye wavenumber) plasma fluctuations, when the usually dominant Cherenkov emission and Landau damping processes are exponentially small. In thermal equilibrium, the spectrum is related to the high frequency conductivity of Depree, Coste and Dawson and Oberman. For long wavelength, $k \sim \epsilon k_D$ and low frequency $\omega \sim \epsilon\omega_p$, "hydrodynamic" fluctuations, where ϵ is the plasma parameter, a kinetic equation is derived for the correlation function of the fluctuating phase space density. By taking moments and using a Chapman–Enskog procedure, it is shown that hydrodynamic fluctuations in a nonequilibrium plasma may be described by a simple modification of the equilibrium theories of Onsager and of Landau and Lifshitz. A new and simple formalism is used, and it is discussed how important extensions of the theory to include such effects as "diffusing orbits" and the enhancement of transport from weakly damped (or even linearly growing) hydrodynamic fluctuations might be made, using this formalism as a rigorous starting point. The spectrum of plasma waves in an in-

homogeneous plasma, parametrically excited by an electromagnetic wave with frequency slightly greater than twice the local plasma frequency, below the threshold of instability, is derived taking into account wave damping and convection effects. In one of the appendices the three particle Mayer cluster function h, is obtained for a many species plasma. (Diss. Abstr. Int., B)

15238 STIMULATED SCATTERING OF ELECTROMAGNETIC WAVES IN A MAGNETISED PLASMA. Bujarbarua, S.; Sen, A.; Kaw, P. (Physical Research Lab., Ahmedabad (India)). Phys. Lett., A; 47: No. 6, 464-465(6 May 1974).

Estimates of threshold powers, growth rates and amplification factors are estimated for stimulated scattering of electromagnetic waves off electrostatic modes in a magnetized plasma. The magnetic field strength is assumed to influence only the electrostatic modes and not the propagation of incident and scattered electromagnetic waves. (auth)

15239 DISPERSION AND STABILITY OF WAVES IN PLASMAS IN THE PRESENCE OF A CORIOLIS FORCE. Verheest, F. (UKAEA Research Group, Abingdon. Culham Lab.). Astrophys. Space Sci.; 28: No. 1, 91-99(May 1974).

The dispersion law for the propagation of waves in cold magnetized plasmas is derived for arbitrary directions of the rotation axis with respect to the static magnetic field. The waves are shown to be stable, not only in the case of a cold plasma, but in any plasma case which yields hermitian mobility tensors. An interesting special case is when the rotation and magnetization axes are parallel, because then for suitable values of rotation and external magnetic field the two effects can cancel each other, though only for one plasma species at the time. The rotation thus decisively affects and shifts the number and width of the existing pass- and stop-bands in a magnetized plasma. The inclusion of thermal effects through a scalar barotropic pressure is not nearly as significant. (auth)

15240 PARAMETRIC UP-CONVERSION OF LANGMUIR WAVES INTO TRANSVERSE ELECTROMAGNETIC WAVES. Lashmore-Davies, C. N. (United Kingdom Atomic Energy Research Group, Abingdon, Eng.). Phys. Rev. Lett.; 32: No. 6, 289-291(11 Feb 1974).

A mechanism is given for the generation of a transverse electromagnetic wave by a finite-amplitude Langmuir wave of lower frequency. The relationship of this effect to the oscillating two-stream instability is indicated and the conditions for its observation experimentally are discussed. (auth)

15241 EXCITATION OF THE PLASMA AND UPPER HYBRID RESONANCES IN A WARM MAGNETOPLASMA BY AN ALTERNATING ELECTRIC DIPOLE. Chasserisux J. M. (Centre National de la Researche Scientifique, Saint-Mour-des-Fosses, France). J. Plasma Phys.; 11: No. 2, 225-252(Apr 1974).

The potential created by an alternating dipole in a warm magnetoplasma is calculated analytically, in the approximation of the full adiabatic theory, for excitation frequencies ω close either to the upper hybrid frequency ω_T or to the plasma frequency ω_p. The potential is finite at these frequencies. For $\omega \sim \omega_p$, the equipotential surfaces can be considered roughly as planes perpendicular to the static magnetic field B. For $\omega \sim \omega_T$ and $\omega_b^2 < 3\omega_b^2$ (where ω_b is the electron gyrofrequency), the equipotential surfaces are cylinders of axis B. On the other hand, if $\omega_p^2 > 3\omega_b^2$, the potential is the sum of a cylindrical wave and of a wave for which the equipotential surfaces are paraboloids of axis B. These results are used to calculate the mutual impedance Z of a quadrupole probe, and it is shown that the measurement of Z at $\omega = \omega_T$ provides a new method for determining the electron temperature. (auth)

15242 ELECTROMAGNETIC SURFACE WAVES SUPPORTED BY A HALF-SPACE OF A COUNTERSTREAMING PLASMA. Ha, K. W.; Seshadr, S. R. (Wisconsin Univ., Madison). Int. J. Electron.; 36: No. 5, 639-648(May 1974).

The characteristics of electromagnetic surface waves supported by a plane interface separating a semi-infinite region of free space from another semi-infinite region consisting of a plasma counterstreaming parallel to the interface are investigated for the case in which the wave is progressing parallel to the direction of the streams. The behavior of the surface waves is quite different from the case in which the plasma is stationary. The surface waves exist for all frequencies. The phase velocity of the surface wave is equal to the electromagnetic wave velocity in free space for very low frequencies, decreases monotonically as the frequency is increased and asymptotically approaches the velocity of the stream for very high frequencies. The surface waves are always stable. In contrast to an unbounded counterstreaming plasma which gives rise to instability for the plane longitudinal wave progressing parallel to the streams, a half-space of counterstreaming plasma does not give rise to any instabilities for waves progressing parallel to the streams. (auth)

15243 RADIATION FIELDS OF HELICAL ANTENNA IN COMPRESSIBLE ELECTRON PLASMA. Talekar, V. L.; Soni, K. R. (Malaviya Regional Engineering Coll., Jaipur, India). Int. J. Electron.; 36: No. 5, 679-686(May 1974).

Expressions for the radiation fields in a compressible electron plasma medium are derived pertaining to the helical antenna of finite size immersed in it. The current distribution on the helical antenna is assumed to be an out-going traveling wave with an arbitrary phase propagation constant. From these general expressions fields of circular loop and linear antennas can be deduced as particular cases. Further, by letting the plasma frequency approach zero in these general expressions, the electromagnetic fields of the usual helical antenna theory can be obtained. It is, therefore, concluded that the radiation field expressions for a helical antenna are of a general nature and cover the cases of circular loops and linear antennas in an electron plasma medium and of the helical antenna in vacuum. (auth)

15244 RADIATION CHARACTERISTICS OF A TRAVELLING-WAVE MULTI-TURN CIRCULAR LOOP ANTENNA IN COMPRESSIBLE ELECTRON PLASMA. Talekar, V. L.; Soni, K. R. (Malaviya Regional Engineering Coll., Jaipur, India). Int. J. Electron.; 36: No. 5, 687-697(May 1974).

The paper is an extension of the authors' previous work (Int. J. Electron; 34: 497 (1973). Ibid. 36: 679 (1974)) on traveling-wave circular loop and helical antennas immersed in an isotropic compressible electron plasma. The expressions for the electromagnetic and electroacoustic components of the radiation field and of radiation resistance in the case of an electrically large multi-turn circular loop antenna in plasma having a travelling-wave current distribution are derived. Finally, treating the multi-turn loop in vacuum as a particular case of the general results for the same in a plasma medium, expressions for electromagnetic field and radiation resistance have been obtained for different loop sizes and the number of turns in it. It is shown that its field and the radiation resistance, both in plasma and in vacuum, are seriously affected by the number of turns in the loop and under certain conditions much higher values of radiation resistance can be obtained. (auth)

15245 PARAMETRIC AMPLIFICATION OF ALFVEN WAVES. Pozwolski, A. Onde Elec.; 53: No. 11, 412-414(Dec 1973). (In French).

The propagation of magnetohydrodynamic waves with velocities modulated by a low frequency magnetic field were studied. It is shown that this modulation results in a compression of the signal and a consequent gain in intensity and frequency in an increasing magnetic field. (FR)

15246 INTEGRATION OF VLASOV EQUATION BY VECTOR METHOD. Chen, N. C. (Ohio Univ., Athens). Int. J. Electron.; 36: No. 5, 629-637(May 1974).

To discuss the small amplitude disturbances propagating through a hot plasma in a uniform magnetic field, or to find the macroscopic quantities of a plasma, it is necessary to solve the Vlasov equation. A general vector method is presented and a solution of the linearized Vlasov equation with a collision term is given. The explicit expressions of the perturbed distribution functions for both anisotropic and isotropic equilibrium distributions are derived. The results can be easily applied to find the dispersion equation and the polarization properties of the waves. (auth)

15247 AMPLIFICATION AND ABSORPTION OF ELECTROMAGNETIC WAVES IN OVERDENSE PLASMAS. White, R. B.; Chen, F. F. (Inst. for Advanced Study, Princeton, NJ). Plasma Phys.; 16: No. 7, 565-587(Jul 1974).

The spatial variation of the amplitude of electromagnetic radiation propagating into an inhomogeneous plasma is discussed in reference to nonlinear interaction of HCN laser radiation with plasmas and to experiments on rf heating of the ionosphere. Previous results on the ordinary wave and on the extraordinary wave at normal incidence are reviewed with emphasis on the physical processes affecting the amplitude behavior. New numerical results are obtained starting from an integral representation of the solution of the wave equation for waves in a cold, inhomogeneous, magnetized plasma slab. Resonance absorption is discussed for the cases of normal incidence in the presence of a magnetic field (the Budden problem) and oblique incidence in the absence of a magnetic field. (auth)

15248 OSCILLATIONS OF A PLASMA CONFINED BY THE MAGNETIC FIELD OF A LINE MULTIPOLE. Burghes, D. N. (Newcastle Upon Tyne Univ., Eng.). J. Plasma Phys.; 11: No. 3, 347-355(Jun 1974).

The problem of confinement and stability of a plasma enveloped by the magnetic field of a line multipole is considered.

An energy method is used to find the increment in potential energy when the configuration is given a small displacement. The frequency and modes of oscillation are found in a particular example. (auth)

15249 THREE-WAVE INTERACTION IN THE PRESENCE OF A HIGH-FREQUENCY ELECTRIC FIELD. Stenflo, L. (Umeaa Univ., Sweden). Plasma Phys.; 16: No. 7, 677-682(Jul 1974).

The nonlinear resonant interaction between three small amplitude waves in a spatially homogeneous plasma, which is situated in an external high-frequency electric field of comparatively large magnitude is considered. The coupling coefficients, which represent the strength of the interaction, are calculated. It is found that they can be significantly changed by the applied field, when the field-induced electron velocities are larger than the thermal speed. The external field can also have a stabilizing effect on nonlinearly unstable systems. (auth)

15250 CROSSOVER FREQUENCIES IN A MULTICOMPONENT PLASMA. Uberoi, C.; Das, G. C. (Indian Inst. of Science, Bangalore). Plasma Phys.; 16: No. 7, 669-676(Jul 1974).

An attempt was made to generalize a method developed earlier for the qualitative assessment of crossover frequencies (existence and behavior) in multicomponent plasmas with one negative ion species to plasmas with any number of positive and negative ion species. It is shown that a great deal of qualitative information can be obtained regarding the crossover frequencies for any given plasma model without recourse to cumbersome numerical study. Possible applications of the study in the interpretation of frequency time spectrograms for the detection of negative ion whistlers and in the measurement of concentrations and masses of negative ions are noted. (auth)

15251 PARAMETRIC EXCITATION AND AMPLIFICATION OF COUPLED WAVES IN A BEAM-PLASMA SYSTEM. Naoulo, M.; Manh, P. T. (Univ., Paris). Plasma Phys.; 16: No. 7, 635-649(Jul 1974).

An experimental and theoretical study of UHF parametric amplification performed with a beam-plasma system is reported. Due to its nonlinear properties, the beam-plasma system is an adequate medium for energy conversion and wave amplification, and this is accomplished by means of mode coupling. High experimental gains have been obtained, which are in good agreement with the theoretical results. (auth)

15252 WAVE PROPAGATION IN A MOVING PLASMA. Pt. I. Wave Propagation Normal to the Magnetic Field and Motion of the Plasma Along the Magnetic Field. Srivastava, D. N. (Bhabha Atomic Research Centre, Bombay). J. Plasma Phys.; 11: No. 3, 389-395(Jun 1974).

The dispersion relation for a collisionless moving electron plasma, when the direction of motion is along the magnetic field, and that of the wave propagation normal to the magnetic field, is analyzed. It is shown that in small magnetic fields the ordinary wave develops a new band of backward waves below the plasma frequency. When the frequency of the wave is higher than the plasma frequency, the effect of the motion of the plasma is identical to a deviation of the direction of propagation. (auth)

15253 ABSORPTION OF MICROWAVE THROUGH LABORATORY PLASMA. Gwal, A. K.; Singh, K. P.; Misra, K. D. (Banaras Hindu Univ., India). J. Inst. Telecommun. Eng.; 19: No. 2, 94-96(Feb 1973).

Propagation of microwave through the laboratory plasma was considered. Effects of inter-particle collision were included in deriving an expression for the reflected microwave pulse from the other end of reflection probe. Effects of electron collisions on the distortion of received signals were discussed. (auth)

15254 PROPAGATION OF ELECTROMAGNETIC AND ELECTROACOUSTIC WAVES THROUGH COMPRESSIBLE ELECTRON-ION PLASMA. Talekar, V. L.; Rawat, S. S. (Malaviya Regional Engineering Coll., Jaipur, India). J. Inst. Telecommun. Eng.; 17: No. 9, 334-336(Sep 1971).

General equations were developed for the propagation of electromagnetic and electroacoustic waves due to a current source in homogeneous, isotropic and compressible two component (electron-ion) plasma employing the linearized two fluid continuum theory of partially ionized plasma dynamics. From these it is shown that the electromagnetic mode is pure and propagates in a specific range of frequency spectrum. As against this, the electroacoustic mode is a mixed mode due to coupling of electron and ion modes but propagates throughout the whole range of frequency spectrum. The results obtained in the present paper are of general nature from which particular cases of propagation treated by earlier workers can be deduced. (auth)

15255 PHASE AND SIGNAL VELOCITIES OF EIGENWAVES IN A BINARY DISSIPATIVE PLASMA. Kranys, M.; Teichmann, J. (Univ. of Montreal). J. Plasma Phys.; 11: No. 2, 289-298 (Apr 1974).

The signal and phase velocities of the possible waves (eigenwaves) in a dissipative binary plasma were studied on the basis of the linearized thirteen-moment theory. The complete set of eigenmodes for the given system was formed using approximations in the range of frequencies high compared with typical collision or plasma frequencies. There were twenty non-trivial propagation modes. Four of them were modes with signal-front speed associated with the induced electromagnetic wave. Eight modes belonged to each of the gas constituents, among them two longitudinal diffusion modes ($\pm W_l$), four transverse viscosity modes polarized respectively along two transverse axes ($\pm W_\perp$ in the direction x^1 and $\pm W_\perp$ in the direction x^2) and two longitudinal thermal modes ($\pm W_{II}$). The signal-front speed of all eigenwaves was lower than the speed of light, so that the system was hyperbolic. The ultra-relativistic plasma was also briefly discussed. In this case, all the mixture constituents would have the same set of signal-front speeds as a single gas, irrespective of the bulk viscosity. Comparison was made of the present theory and results with other theories (for some special cases). (auth)

15256 FRACTIONAL HARMONICS IN A PLASMA. Lewak, G. J.; Lee, N. J. (California Univ., La Jolla). J. Plasma Phys.; 11: No. 2, 325-329(Apr 1974).

The most common approach to the study of plasma nonlinearities is by a form of perturbation theory which first studies the linearized equations, then evaluates effects of nonlinearities in terms of these linear solutions. Such an approach is probably justifiable for the effect of weak nonlinearities, but will almost certainly miss features that are exclusively nonlinear in nature (i.e., effects which cannot be described by modifying linear theory, or effects which are present only when e.g. a source of disturbances in a plasma reaches a certain threshold amplitude). Weakly nonlinear behavior, which has been investigated by perturbation theory, predicts wave decay, which could be interpreted as a generalization of subharmonic generation, since the frequency of the generated waves must, in general, be lower. The possibility of fractional harmonic generation, independently of the requirements of the plasma wave decay, has not been investigated. It is this part of the problem that is investigated. (auth)

15257 SPATIAL EVOLUTION OF FINITE-AMPLITUDE PLASMA WAVES IN COLLISIONLESS PLASMAS. Tsai, S. T. (Maryland Univ., College Park). J. Plasma Phys.; 11: No. 2, 213-223(Apr 1974).

A numerical simulation concerning the spatial evolution of electron plasma waves and electron distributions in collisionless plasmas is performed. Only those particles in and around the resonant region are followed numerically, while the bulk plasma is treated analytically. The results are in good agreement with existing theoretical results as well as experimental observations. The method introduced here is valid for waves with arbitrary amplitude. It does not depend on either a large-amplitude asymptotic expansion or a small-amplitude perturbation scheme. (auth)

15258 THEORY FOR SCATTERING BY DENSITY FLUCTUATIONS BASED ON THREE-WAVE INTERACTION. Harker, K. J.; Crawford, F. W. (Stanford Univ., CA). J. Plasma Phys.; 11: No. 3, 435-450(Jun 1974).

The theory of scattering by charged particle density fluctuations of a plasma is developed for the case of zero magnetic field. The source current is derived on the basis of, first, a three-wave interaction between the incident and scattered electromagnetic waves and one electrostatic plasma wave (either Langmuir or ion-acoustic), and secondly, a synchronous interaction between the same two electromagnetic waves and the discrete components of the charged particle fluctuations. Previous work is generalized by no longer making the assumption that the frequency of the electromagnetic waves is large compared to the plasma frequency. The general result is then applied to incoherent scatter, and to scatter by strongly driven plasma waves. An expansion is carried out for each of these cases to determine the lower order corrections to the usual high-frequency scattering formulas. (auth)

15259 COMPARISON OF QUASI-LINEAR PREDICTIONS WITH A COMPUTER SIMULATION OF WHISTLER WAVES IN UNSTABLE PLASMAS. Cuperman, S.; Lyons, L. R. (National Oceanic and Atmosphere Administration, Boulder, CO). J. Plasma Phys.; 11: No. 3, 397-401(Jun 1974).

The quasi-linear concept of plateau formation along resonant diffusion surfaces is compared with the time evolution of the

electron distribution function during a computer simulation experiment of whistler-mode waves in unstable plasmas. It is found that, as the wave intensities grow, plateau formation does indeed occur, with the distribution function becoming constant along diffusion surfaces at the time when wave intensities maximize. Following the formation of the plateaus, both the wave intensities and the slope of the distribution function along diffusion surfaces oscillate in a manner suggesting mode-mode coupling. The slope of the distribution function along diffusion surfaces, which controls the linear wave growth rate, also gives good predictions of the sign of the actual wave growth rate during the experiment. (auth)

15260 LOW-FREQUENCY SURFACE WAVES ON BOUNDED WARM MAGNETOACTIVE PLASMA. Zhelyazkov, I.; Nenovski, P. (Univ., Sofia). J. Plasma Phys.; 11: No. 2, 311-323(Apr 1974).

The spectra of low-frequency surface waves propagating along a warm magnetoplasma layer bounded by a dielectric are investigated, using a two-fluid hydrodynamic plasma model. It is shown that such propagation is possible only for some definite directions of the external magnetic field B_0, with respect to the plasma–dielectric interfaces. The spectra obtained for a thick plasma layer correspond to the well-known results for a magnetoactive plasma, bounded on one side by a vacuum, derived in the limit of one-fluid hydrodynamics. (auth)

15261 HIGH-FREQUENCY SURFACE WAVES ON A SEMI-BOUNDED WARM CURRENT PLASMA. Shivarova, A. P. (Univ. of Sofia). J. Phys., A (London); 7: No. 7, 881-888(1 May 1974).

This paper investigates the dispersion relation and the time and space damping rates of the high-frequency surface waves propagating on a warm homogeneous nonisothermal current plasma bounded by a vacuum. The description is done on the basis of a kinetic plasma theory under the specular reflection condition for particles at the plasma–vacuum boundary. (auth)

ENGINEERING

Energy Conversion

15262 (JPRS-62129) EXPERIENCE FROM THE FIRST STAGE OF DEVELOPMENT OF THE U-25 INSTALLATION. Sheyndlin, A. E.; Nedospasov, A. V.; Pashkov, S. A.; Pinkhasik, D. S.; Pishchikov, S. I.; Sidorov, V. S.; Telegin, G. P.; Shelkov, E. M.; Shumyatskii, V. Ya. (Joint Publications Research Service, Washington, D. C. (USA)). 1973. Translation of Opyt Pervogo Etapa Osvoyeniya Ustanovki U-25. 22p. NTIS.

A description of the U-25 installation which is an experimental combined power plant with an open-cycle MHD generator is presented. (auth)

15263 (JPRS-62139) PROSPECTS FOR MHD POWER PLANTS IN POWER ENGINEERING. Kirillin, V. A.; Melent'ev, L. A.; Sheyndlin, A. E. (Joint Publications Research Service, Washington, D. C. (USA)). 1974. Translation of O Perspektivakh MGD Elektrostantsiy v Energetike. 20p. NTIS.

The basic results of the first phase of development of the U-25 installation are reviewed. (auth)

15264 INVESTIGATION OF THE SURFACE OF CARBIDE-COMPOUND THERMIONIC EMITTERS BY AUGER-ELECTRON SPECTROSCOPY. Kul'varskaya, B. S.; Cherevatskii, N. Ya. (Inst. of Radio Engineering and Electronics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 827(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1303-1304(Jun 1973).

Emitters made of refractory compounds, particularly of the carbides of transitional and refractory metals, are of great importance in modern technology because they can withstand high temperatures. Various suggestions concerning the emission mechanism of these materials have been offered. According to one theory, the structure of the electron states of isolated atoms forming the particular compound is one of the factors determining the emissivity. Another theory assumes that the emission from refractory materials, particularly from carbides, depends upon the excess concentration of the metal forming the carbide (e.g., Zr atoms in the case of ZrC) in the near-surface layer. In research on the surface composition of these materials and on the processes occurring on the surfaces, Auger electron spectroscopy was used with the surfaces functioning as electron emitters. Auger electron spectroscopy allows direct determinations of the composition of the surface to depths of several atomic layers and has a sensitivity of as much as 10^{13} atoms/cm^2. (RCK)

15265 EFFECT OF MAGNETIC PRESSURE IN A HIGH-CURRENT THERMIONIC CONVERTER. Nevolin, V. K.; Tsiberev, V. P.; Tskhakaya, V. K.; Yarygin, V. I. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 822-823(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1298-1300(Jun 1973).

Preliminary results are reported for an experimental study of the effect of magnetic pressure on the operation of a thermionic converter. The redistribution of the current-density profile in the converter is studied as a function of the total current through the converter. (auth)

15266 EFFECT OF NONLINEARITY OF THE MEDIUM CONDUCTIVITY ON OPERATING PARAMETERS OF A HALL-TYPE MHD GENERATOR. Pelz, P. (Electrotechnical Inst., Prague). Elektrotech. Obz., 62: No. 5, 270-275(May 1973). (In Czech).

Formulas are derived for calculating the operating parameters of a Hall type closed-cycle MHD generator. The effect of the Joule heating on the increased conductivity of the working medium of the generator is considered. Nonlinear conductivity is approximated using a simple substitutive characteristic. The derived relations are tabulated. The theoretical calculations are supplemented with a numerical example. (Nuclear Sci. Abstr. Czech.)

15267 POSSIBILITY OF MHD TRANSFORMATION OF ENERGY FROM PULSED THERMONUCLEAR REACTORS. Velikhov, E. P.; Chernukha, V. V. At. Energ. (USSR); 36: No. 4, 258-260(Apr 1974). (In Russian).

The possibility of using certain conduction and induction MHD-generator schemes for transforming energy from pulsed thermonuclear reactors in which energy release occurs in a blanket that absorbs the major part of hard radiation is discussed. The physical limitations on achievable transformation efficiency, obtainable plasma parameters in the reactor (pressure ~1 kbar, temperature ~2-3 eV), and choice of working body are elucidated. Approximate parameters of a Faraday ultrasonic plasma MHD generator with solid electrodes (efficiency ~0.4) and a piston induction MHD generator (efficiency 0.6), generating current and voltage alternating in time, are presented. (auth)

Facilities and Equipment

Refer also to abstracts 15572, 17091, 17302, 17487, 17500, and 17661.

15268 (COO-2007-45) STUDY OF THE NEON-OXYGEN LASER UNDER HEAVY PARTICLE BOMBARDMENT. Seckinger, E. L. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). 1974. 105p. Dep. NTIS $8.25.

Thesis.

Experiments are described which explore the possibility of using a heavy particle external ionization source as the energy input or "pump" for the Ne-O_2 laser. Also described are the electrically excited Ne-O_2 laser and the theory behind its operation and the theory behind the "heavy particle bombarded" excited laser. The heavy particles consist of the alpha and lithium particles produced by the reaction of thermal neutrons on a boron-10 coating surrounding the plasma. Theoretical studies show that with the neutron flux that can be obtained in the TRIGA reactor these particles should cause lasing in the gas mixture if an optical cavity exists. No conclusive evidence was obtained, though, that showed lasing, but in a few instances possible lasing was suggested by indirect measurements. (auth)

15269 (HWS-5967) SPECIFICATIONS FOR FUELS RECYCLE PILOT PLANT. Byrd, W. D. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 15 Nov 1962. 468p. Dep. NTIS $26.50.

Detailed specifications for the Fuels Recycle Pilot Plant, Building 324 at Hanford, Washington are presented. Specifications are included for the building excavation and site grading, structural materials, piping and plumbing, heating and ventilation, doors and hardware, sprinkler system, materials handling equipment, communications systems, electrical equipment, shielding, instrumentation, special furnishings, roads, and exhaust stack. (LCL)

15270 (KFK-1876) APPLICATION OF THE HEAT PIPE PRINCIPLE TO AVOID THE ERROR DUE TO THE EMERGENT STEM IN LIQUID-IN-GLASS THEROMETERS. Reiss, F. E. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Dec 1973. 19p. (In German). INIS.

8 figs.; 6 refs. With abstract in German and English.

The error due to the emergent stem with liquid-in-glass thermometers can be avoided by heating the capillary of the thermometer with a heat pipe to the temperature of the bath. Experimental investigations show that full compensation of the error can be achieved by proper design. (GE)

15271 (KFK-1909) REGEN-A FORTRAN PROGRAMME FOR THERMOHYDRAULIC DESIGN OF A COOLING TOWER OF THE REGENERATIVE TYPE. Neitzel, H. J.; Wiehr, K. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorbauelemente). Feb 1974. 26p. (In German). INIS.

2 figs.; 5 refs. With abstract in German and English.

A FORTRAN-IV-Program called REGEN was developed which serves as a basis for thermohydraulic design of a dry-type cooling tower functioning on the regeneration technique. The physical relationships for the design calculations as well as a description of the program are presented. (GE)

15272 (LA-5562-MS) ELECTRON TRANSPORT COEFFICIENTS AND VIBRATIONAL EXCITATION RATES FOR ELECTRICALLY EXCITED CO_2 GAS LASERS. Elliott, C. J.; Judd, O. P.; Lockett, A. M.; Rockwood, S. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 35p. Dep. NTIS $4.00.

Electron transport coefficients and vibrational excitation rates were calculated for gas mixtures appropriate for electrically excited CO_2 lasers. The basis of the calculations is a detailed numerical solution of the Boltzmann transport equation which incorporates experimentally determined cross sections for the most important inelastic electron collision processes in the gas. The effects of elastic and superelastic collisions and charged particle interactions have also been included in the formalism. Graphical presentations of electron drift velocity, average energy, characteristic energy, and vibrational excitation rates in a range

$10^{-16} < E/N \leq 5 \times 10^{-16}$ Vcm^2 are obtained for nine CO_2-N_2-He gas mixtures. The excitation rates are also presented in a form normalized to average electron energy. Using this normalization, the electron excitation rates for the three vibrational modes in CO_2 are found to be independent of gas mixture within a 20% approximation. The dominant effect of gas mixture on electron kinetic processes is to modify the vibrational excitation rate in the nitrogen. The implication of these results to the basic kinetics of the CO_2 laser is discussed. (auth)

15273 (LA-5607-MS) LASER PULSE PROPAGATION CODE. Suydam, B. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 14p. Dep. NTIS $4.00.

A code is described which propagates an axisymmetric pulse of light through optical systems of many elements such as: (a) laser amplifiers, (b) lenses, apertures and telescopes, and (c) air gaps between elements. Full account is taken of diffraction, nonlinear laser gain and the self-focusing effects of a nonlinear refractive index. This report describes the algorithms used in the calculation, which appear now to have stabilized. Actual coding details and subroutines, which will probably remain in a state of flux so long as the code is active, are not discussed. (auth)

15274 (SAND-74-5006) LASER DOPPLER VELOCIMETRY IN CHEMICAL LASER STUDIES. Hackett, C. E.; Waypa, J. (Sandia Labs., Albuquerque, N. Mex. (USA); Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). 1974. 17p. (CONF-740337-1). Dep. NTIS $4.00.

From LDV conference; West Lafayette, Indiana, USA (27 Mar 1974).

An experimental investigation of the gas kinematics in the mixing zone downstream of various supersonic nozzle arrays for use in chemical laser systems was conducted in the Chemical Laser Laboratory of the Air Force Weapons Laboratory (AFWL). The design considerations and experimental application of a scanning laser Doppler velocimetry (LDV) system for use in this investigation is reported. The problem of dielectric seeding of the low density supersonic gas streams was addressed and was in part circumvented by Lagrangian condensation reaction techniques. The LDV system incorporated a servo-driven scanning feature which enabled the Doppler sensing region to be swept in planes parallel to the face of the mixing nozzle array. Results were compared to hot-wire anemometry, and are found to be satisfactory. (auth)

15275 (TT-74-50011, pp 259-272) PRELIMINARY DATA ON THE MEASUREMENT OF THE ATMOSPHERIC AEROSOL CHARACTERISTICS WITH A CENTRIFUGAL SPECTROMETER. Redkin, Yu. N. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

An aerosol spectrometer that makes it possible to obtain continuous spectra of particles for Stokes radii R_S between 0.4 and 10μ is examined. A relationship $\varphi = \varphi(R_S)$ whose log-log plot for particles of $R_S \geq 10^{-4}$ cm is almost a straight line is derived from the equation of particle motion in a viscous space for a rotating system of coordinates. Here φ is the angle of particle deviation from a radius passing through the point from which the particle started moving. The spectrometer model was built as a hollow, rotating steel disk, through the axis of which aerosol is pumped. Owing to centrifugal sedimentation, part of the dust penetrates special slots to form a pencil of rays splitting more and more as the particles move away from the axis of rotation. The coarser the particle, the larger the angle of its deviation. A theoretical evaluation of the efficiency of this device showed it to depend very little on particle size at $R_S > 10^{-4}$ cm (being 65 to 70%), as confirmed by the results of a calibration using puffball and lycopodium spores. The distribution of α-activity of particles of $R_S = 0.4 \cdot 10^{-4}$ cm varies little and is almost only a hundredth of the specific overall α-activity measured on an FPP filter. (auth)

15276 (UCID-16525) LAMP CODE USERS GUIDE. Thompson, P. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 17 Jun 1974. Contract W-7405-Eng-48. 68p. Dep. NTIS $6.50.

15277 (UCRL-13597) CHARACTERIZATION OF SELF-FOCUSING MECHANISMS IN LASER MATERIALS. Interim Final Report, February 14, 1974. Hellwarth, R.; Cherlow, J.; Yang, T. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.; University of Southern California, Los Angeles (USA). Electronic Sciences Lab.). 1974. 24p. Dep. NTIS $4.25.

The time dependence of the nonlinear optical susceptibility tensor of fused quartz and the laser glasses ED-2 (from Owens Illinois) and LSO, C1020, and C2828 (from American Optical) was studied. This will allow computation of any nonlinear optical effect involving frequencies below the electronic bandgap and above frequencies at which nuclear motions respond. The relative contributions of the "electronic" and "nuclear" nonlinearities to the self-focusing index for linearly polarized light in these glasses were determined; the electronic contribution dominates (~85%) in each. The implications of these results for laser-material selection are discussed. (auth)

15278 PENNSYLVANIA NUCLEAR SCIENCE PROGRAM: SIGNIFICANT PUBLIC EDUCATION PROGRAM. Jester, W. A. (Pennsylvania State Univ., University Park); McDermott, J. J.; Diethorn, W. S. Trans. Amer. Nucl. Soc.; 18: 32-33(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, Pennsylvania (23 Jun 1974).

15279 ROLE OF NUCLEAR ENGINEERING STUDENTS IN PUBLIC UNDERSTANDING OF NUCLEAR POWER. Tsoulfanidis, N. (Univ. of Missouri, Rolla). Trans. Amer. Nucl. Soc.; 18: 33(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, Pennsylvania (23 Jun 1974).

15280 MANPOWER SUPPLY AND DEMAND FOR THE NUCLEAR INDUSTRY. Chewning, J. S. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 33-34 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania (23 Jun 1974).

15281 PUBLIC EDUCATION THROUGH THE NEIGHBORHOOD SHORT-COURSE CONCEPT. Long, R. L. (Univ. of New Mexico, Albuquerque). Trans. Amer. Nucl. Soc.; 18: 39-40 (Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15282 ENGINEERING AND PUBLIC SERVICE. Lidofsky, L. J. (Columbia Univ., NY). Trans. Amer. Nucl. Soc.; 18: 40(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15283 DESIGN AND PERFORMANCE CHARACTERISTICS OF THE PUMP FOR THE FEFP LOOP. Thompson, D. H. (Argonne National Lab., IL); McDaniel, M. J.; Robinson, L. E. Jr.; King, E. C.; Wahl, M. H.; Ciarlariello, T. A. Trans. Amer. Nucl. Soc.; 18: 101(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15284 SHIELDING DESIGN FOR A HIGH-INTENSITY FLASH X-RAY FACILITY. Gordon, J. D.; Dresser, M. M.; Larson, W. A. (TRW Systems, Redondo Beach, CA). Trans. Amer. Nucl. Soc.; 18: 370(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15285 LASER WITH RADIATION FREQUENCY SCANNING. Lopasov, V. P.; Makogon, M. M.; Tyryshkin, I. S. (Inst. of Atmospheric Optics, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 123-125(1974). (In Russian).

In order to attain high resolution for use in laser spectroscopy, especially in studying the finer structure of absorption spectra in gaseous medium it is necessary to have lasers with a changed radiation frequency and a narrow spectrum. In this study, the radiation frequency of a ruby laser is changed by use of an electro-optical filter as the dispersion element. The energy, the radiation intensity as a function of time, and a time scan of the radiation spectrum of a ruby laser were investigated with the improved electro-optical system. The studies showed that a laser with slow scanning of the radiation frequency (up to 0.05 cm^{-1}/microsec) can be used in laser spectrometry. Additional studies are needed at higher scanning rates. (SJR)

15286 FREQUENCY MODULATION OF GAS LASERS WITH MULTIMIRROR RESONATORS. Arkhipkin, V. G.; Popov, L. N.; Fomin, V. D. (Siberian Physical-Technical Inst., Tomsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 145-146(1974). (In Russian).

Frequency modulation is preferred in transmitting information by an optical system of communication. Two arrangements of a three-mirror gas-laser system with a single-frequency modulation are analyzed, and shown to be feasible. The advantages of the system are a high amplification coefficient and single frequency operation. The disadvantages involve accurate mirror positioning and an increase in resonator length which leads to a decrease in frequency deviation at the same amplitude of the modulating signal. (SJR)

15287 WELDING OF REACTOR PRESSURE VESSELS. Tanaka, H.; Tanaka, O. (Kobe Steel Ltd., Japan). FAPIG (Tokyo); No. 67, 189-197(Nov 1972). (In Japanese).

The welding of nuclear reactor pressure vessels is described in reference to the welding materials to be used in butt welding and internal build-up welding. The butt welding of vessel body and nozzle corner was performed by covered electrode welding or submerged arc welding. BL-96 was utilized for the covered electrode for A-533B Class-1 and A-508 Class-2 steels. The BL-96 is suitable for welding rods of low-hydrogen type corresponding to AWS A-5.5-69 E9016G. BL-106 is suitable for welding rods for A-533B Class-2. Deposited metals of BL-96 and BL-106 have excellent mechanical properties and toughness, and have good anti-cracking characteristic even after the heat treatment for long time. As the welding wire for the submerged arc welding, US-56B was used for A-533B Class-1 steel and US-63B was used for Class-2 steel. MF-27 was used as the flux for every type of steel. Welding methods employed include single-pole welding and tandem welding for Class-1 steel and single-pole welding for Class-2 steel. Redrying of the welding rods of BL-96 and BL-106 must be performed for 30 to 60 min at temperatures from 300 to 350°C. If the redrying is not sufficient, the rods may be sensitive to delayed cracking. Redrying of the flux of MF-27 must be performed for about one hour at temperatures from 200 to 250°C. (JA)

15288 VAPOR GENERATOR. Barratt, R. O. (to Foster Wheeler Corp.). British Patent 1,347,303. 20 Feb 1974. Filed date 18 Aug 1971. 7p.

A vapor generator for liquid Na is described that comprises an elongated vessel, with an inlet and an outlet for a single phase primary heat exchange fluid (Na), with means for maintaining a reservoir of this fluid in the vessel. A bank of tubes is arranged axially within the vessel for carrying a vaporizable secondary fluid (H_2O) in indirect heat exchange with the primary fluid so as to obtain a mixture of liquid and vapor in the tubes. Each tube includes an outer section formed by a wall having a series of perforations, also a separator tube section formed by a second wall coaxial with and spaced from the outer surface of the first wall adjacent the perforations. Means are provided in each of the outer tube sections to form a helical flow path for the two-phase mixture of liquid and vapor, the arrangement being such that, in operation, the mixture swirls upwardly through the outer tube and the vapor leaves the tube through an upper opening while the liquid passes through the perforations to the separator tube section. The tube bank assembly serves to increase the heat flux experienced by the evaporator from the initial heat of the hot Na. This increases the two-phase fluid exit quality without departure from nucleate boiling, while still maintaining a down-flow Na circuit and avoiding the Na stagnation problems associated with up-flow Na systems. Various constructional alternatives are also described. The system may be applied to fluids other than Na and H_2O. (auth)

15289 LASER BREWSTER WINDOW SEALING TECHNIQUES. Smith, B. (Army Electronics Tech. and Devices Lab., Fort Monmouth, NJ). IEEE (Inst. Elec. Electron. Eng.), J. Quant. Electron.; QE-9: No. 5, 546-548(May 1973).

The application of the Wallis and Pomerantz electrostatic sealing technique to low-temperature glass-to-glass vacuum tight optical window seals is discussed. The successful sealing of vacuum tight quartz optical windows to quartz tubing at the Brewster angle is described and problem areas are defined. A brief discussion of the sealing mechanism is given and the general equations are defined. (auth)

15290 SHOCK-WAVE TERMINATION OF LASER ACTION IN COAXIAL FLASH LAMP DYE LASERS. Evanizky, T. F.; Wright, R. H. Jr.; Theissing, H. H. (Army Electronics Command, Fort Monmouth, NJ). Appl. Phys. Lett.; 22: No. 10, 520-521 (15 May 1973).

Shock-wave-induced optical distortion of dye laser solutions in conventional coaxial flash lamps has been observed. An inwardly propagating radial shock wave is generated in the solution upon flash lamp discharge, causing virtually complete scattering of axially directed light within a few microseconds. Laser action is prematurely terminated since rapidly induced optical distortion becomes a substantial impediment during the period of effective laser pumping. (auth)

15291 FAR INFRARED ISOLATOR. Boord, W. T. Cleveland, OH; Case Western Reserve Univ. (1973). 153p. University Microfilms Order No. 74-10,774.

Thesis (Ph.D.).

It was determined that optical isolators for linearly polarized laser beams of moderate power may be constructed with n-type InSb as the active element. The effect utilized in the device is the Faraday effect in InSb. The total Faraday rotation at 10.6 μ is the sum of several contributing effects, the largest of which is the free electron Faraday effect. Interband transitions and electronic transition between the bound energy levels of complex crystal imperfections also contribute to the total Faraday rotation at 10.6 μ. The absorption coefficient of InSb varies with supplier and with the type of donor, being larger for S doped InSb than for Te doped InSb. In a typical device, the InSb wafer is 0.38 mm thick, is maintained at liquid nitrogen temperature, has a net uncompensated donor (Te) concentration of about 1×10^{17}/cc and provides a 45° rotation in a field of 4.6 kilogauss. The power dissipated in the InSb wafer is approximately 26% of the power incident on the wafer. There is no thermal runaway, focusing, or defocusing for incident power densities up to 75 watts/cm^2. The quality of the isolation depends primarily on the quality of the analyzers used. (Diss. Abstr. Int., B)

15292 PARAMETERS IN A DYNAMICALLY COMPRESSED XENON PLASMA LASER. Papayoanou, A.; Buser, R. G.; Gumeiner, I. M. (Army Electronics Command, Fort Monmouth, NJ). IEEE (Inst. Elec. Electron. Eng.), J. Quant. Electron.; QE-9: No. 6, 580-585(Jun 1973).

Laser action from triply ionized xenon was found to occur during the dynamic contraction of the xenon plasma column. Laser lines between the near ultraviolet and the orange portion of the spectrum were detected. Their peak powers, time of occurrence, duration, wavelength, and coherence length were measured. Optimum currents and pressures were found and compared with other published results. In addition, a simplified model of a pinching plasma was used in conjunction with streak camera picture of the contracting column and time-resolved interferometric measurements of the electron density to estimate electron temperatures. Values of the electron density, temperature, and conductivity of the xenon plasma compare well with published results applicable to high-current pulsed-argon ion lasers. (auth)

15293 DESIGN AND DEVELOPMENT OF A CO LASER AND INTERPRETATION OF ITS INFRARED SPECTRA. Roh, W. B. Columbus, OH; Ohio State Univ. (1973). 127p. University Microfilms Order No. 74-11,038.

Thesis (Ph.D.).

Molecular laser emissions have provided a new source of information for studies in molecular spectroscopy. This is due to the fact that in molecular lasers it has been possible to observe transitions not attained in conventional spectroscopic studies. For instance, in the case of the CO molecule, the infrared spectra obtained by conventional studies have reached only v values up to 6 or 7, whereas CO laser transitions involve transitions between levels reaching as high as v = 37, which represents about 70 percent of the dissociation energy of the CO molecule in its ground electronic state. A Q-switched, liquid nitrogen cooled CO laser was designed and constructed to enable the study of its spectrum with a high resolution vacuum infrared grating spectrograph. The lasing conditions have been optimized to observe transitions between levels v = 3 to v = 37. The CO laser lines have been measured relative to accurately known CO_2 laser lines excited in the same laser tube. The spectral positions determined are average values of many repetitions. The refinement achieved in the present investigation has been demonstrated. The extension of the present measurements to v = 37 as compared to v = 28 achieved before has shown the need to reevaluate the molecular constants and the potential function applicable to the ground electronic state of the CO molecule. The present data are useful in numerous experiments currently in progress elsewhere in other laboratories. (Diss. Abstr. Int., B)

15294 INDIUM GALLIUM ARSENIDE AND INDIUM ARSENIDE PHOSPHIDE INJECTION LASERS AND RADIATIVE RECOMBINATION IN NITROGEN–ZINC–DOPED GALLIUM ARSENIDE PHOSPHIDE. Campbell, J. C. Urbana, IL; University of Illinois (1973). 128p. University Microfilms Order No. 74-11,966.

Thesis (Ph.D.).

Two problems relevant to electroluminescent devices were investigated: (1) $In_xGa_{1-x}As$ and $InAs_xP_{1-x}$ p-n junction lasers were examined as possible high-performance sources of coherent radiation at wavelengths in the neighborhood $\lambda \gtrsim 1$ μm and (2) the role of N in conjunction with Zn in Zn-N-doped $GaAs_{1-x}P_x$ has been studied. Prior to obtaining improved performance from $In_xGa_{1-x}As$ and $InAs_xP_{1-x}$ laser diodes, it has been necessary to develop new crystal synthesis techniques. Difficulties inherent to synthesis of these III-V compound ternary alloys are discussed and it is concluded that crystal growth must occur at constant temperature. Two methods of crystal synthesis which solve this problem, a modified Bridgman technique and constant-temperature liquid-phase epitaxy, are explained. (Diss. Abstr. Int., B)

15295 CONTINUOUS UNIFORM EXCITATION OF MEDIUM-PRESSURE CO_2 LASER PLASMAS BY MEANS OF CONTROLLED

AVALANCHE IONIZATION. Hill, A. E. (Air Force Weapons Lab., Kirtland AFB, NM). Appl. Phys. Lett.; 22: No. 12, 670-673 (15 Jun 1973).

A sequence of 50 to 75 ns high-voltage pulses in combination with photoionization produce spatially uniform continuous electron densities of 2×10^{11} with a 10 to 20 percent ripple at 20,000 Hertz in 150 torr CO_2 laser mixes. A separate continuous electric field ranging from 3 to 6 KV/cm atm is used to heat the electrons, which loads greater than 0.25 J/cc-atm into the plasma without arc breakdown. As is the case with E-beam plasmas, E/P and n(e) may be controlled independently. Hence, electron beams, flow constrictions, etc. are not necessary to produce uniform plasmas for cw high power electric gas laser systems. (auth)

15296 EFFECT OF INHOMOGENEOUS HIGH-FREQUENCY ELECTRIC FIELD ON PLASMA AND SOME CHARACTERISTICS OF CO_2 GAS LASERS. Belous, V. V.; Kostin, V. N. (Kharkov State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 4, 67-71(1974). (In Russian).

It was shown that the superposition of an axially symmetric inhomogeneous hf field with a frequency from 10^{-3} to 25 μHz on the positive column of a steady discharge in a CO_2 gas laser, causing a contraction of the column, leads to a decrease of the generation power which can be explained by an increase of the gas temperature and the average electron energy and by the decrease of the "effective" generation volume. (tr-auth)

15297 AEROSOL FILTRATION SYSTEMS FOR THE EXHAUST AIR FROM NUCLEAR ENGINEERING FACILITIES. Ohlmeyer, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Patente und Lizenzen); Stotz, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Bauwesen). Kerntechnik; 15: No. 9, 416-423(Sep 1973). (In German, English).

8 figs.; 1 tab.; 9 refs.

Problems connected with the design and operation of aerosol filtration systems in nuclear engineering facilities are discussed with particular reference to the stipulations laid down in the First Radiation Protection Ordinance. A filtration system is described which was developed at the GfK on the basis of these stipulations and the experience available so far in connection with assembly, maintenance, filter change and decontamination procedures and of malfunctions at such facilities is reviewed. The system has proven its worth in practical use and satisfies the requirements of both safety and economy. (GE)

15298 THE DYNAMIC CALCULATION OF ANY COMPLEX PIPEWORK SYSTEMS UNDER EARTH PRESSURE IN ACCORDANCE WITH THE RESPONSE-SPECTRUM PROCEDURE. Mueller, P. (Brown, Boveri und Cie A. G., Mannheim (F. R. Germany)). VGB Kraftwerkstech.; 54: No. 4, 262-268(Apr 1974). (In German).

4 figs.; 5 refs.

The response-spectrum procedure proved to be a useful method for determining the vibrational behavior of nuclear power station components under earth pressure excitation. Publications to date have been confined to the geometries to which the model of consistent deflection conditions is applicable. The procedure is extended to the more common example of linear, triaxially movable systems (pipework). (GE)

15299 EFFECTS OF CAVITY CONFIGURATION AND POSITION OF THE ACTIVE MEDIUM ON THE TEMPORAL CHARACTERISTICS OF A SOLID-STATE LASER. Chernov, V. A. (Leningrad Polytechnical Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 698-699(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1095-1097(May 1973).

An experimental study is made of the operating modes of a neodymium-glass laser with a cavity formed by planar and spherical mirrors. The radiation pulsations are studied as functions of the cavity configuration and the position of the active medium in the cavity. The conditions under which the operation becomes quasicontinuous with minimum pulsations are determined. (auth)

15300 LASING IN A $POCl_3 \cdot SnCl_4 \cdot Nd$ LIQUID LASER. Kaporskii, L. N.; Kalabushkin, O. I. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 700-701(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1097-1099(May 1973).

It has been shown theoretically that the lasing of a solid-state laser with passive Q switching is determined by a dimensionless parameter characterizing the modulating power of the absorbing filter. If this parameter is small the laser operates in a spiking regime with a more or less constant period between the spikes. As the modulating power of the filter is increased a regime is observed in which the light is emitted as a series of pulses, the duration of the pulses approaching the duration of a single pulse and the amplitude and repetition period of the pulses being appreciably greater than in the free lasing regime. With further increase of the filter modulating power the self-oscillation regime goes over into the single pulse operation. It is shown that this regime can be achieved in a laser using as an active medium a liquid $POCl_3 \cdot SnCl_4 \cdot Nd$ inorganic system. (MOW)

15301 INFLUENCE OF THE FARADAY EFFECT ON THE BEAT FREQUENCY OF A He–Ne RING LASER. Petrun'kin, V. Yu.; Nikolaev, V. M.; Okunev, R. I.; Kozhevnikov, N. M. (Leningrad Polytechnic Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 702-703(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1099-1101(May 1973).

An experimental study was made of the effect of an external axial magnetic field, applied to a small section of one of the discharge tubes, on the frequency characteristics of a He-Ne ring laser ($\lambda = 0.63$ μ), whose resonator contains a linear quarter-wave phase plate. The experimental data agree well with the results calculated for this laser by the Jones method. The angle of rotation of the polarization direction in the laser active medium is determined. (auth)

15302 CONTROL OF LASER PULSE SHAPE WITH AN ORGANIC-DYE SHUTTER. Pashchenko, V. Z.; Rubin, L. B. (Moscow State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 635-637(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1004-1008(May 1973).

A method is proposed for reducing the width and sharpening the slope of laser pulses; the method is based on absorption of the fundamental frequency of a neodymium laser at an excited level of a molecule of dye that is excited by the second harmonic of the same laser. The operation of the shutter is considered analytically, and experimental data are given regarding the reduction of the width and sharpening of the slope of the trailing edge of the laser pulse. (auth)

15303 0.63-μ NEON LASER WITH NONLINEAR ABSORPTION. Dindarov, V. E.; Kotov, O. I. (Leningrad Polytechnic Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 638-639(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1009-1012(May 1973).

An experimental investigation is reported of mode selection, frequency hysteresis, and power resonance in a nonlinear absorption gas laser in which the amplifying and absorbing elements use a natural mixture of neon isotopes. (auth)

15304 UNSTABLE RESONATORS WITH A CENTRAL COUPLING APERTURE IN LASERS AND LASER AMPLIFIERS. Anan'ev, Yu. A.; Sherstobitov, V. E. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 640-646(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1013-1023(May 1973).

An analysis of the self-excitation conditions for unstable resonators with a central coupling aperture is used to consider the possibility of using such resonators in lasers and laser amplifiers. These possibilities are illustrated experimentally. (auth)

15305 DYNAMICS OF A SEMICONDUCTOR LASER WITH INTENSITY-DEPENDENT INDEX OF REFRACTION. Allakhverdyan, R. G.; Oraevskii, A. N.; Suchkov, A. F. (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 5, 647-649(Nov 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 5, 1024-1028(May 1973).

Numerical methods are used to obtain an exact solution of the self-consistent electrodynamic problem including the effect of nonlinearity in the index of refraction in a semiconductor laser. The field dynamics and inverse population distribution in emission of a light pulse are investigated. A comparison is made of the values of the nonlinearity factor α_2^1 that are needed for self-modulation for a given self-consistent solution of the problem and in an approximate model. (auth)

15306 SIMULTANEOUS Q-SWITCHING AND MODE-LOCKING IN THE CW Nd:YAG LASER. Kuizenga, D. J.; Phillion, D. W.; Lund, T.; Siegman, A. E. (Stanford Univ., CA). 9: No. 3, 221-226(Nov 1973).

The theory of transient mode-locking for an active modulator in a laser with a homogeneously broadened line is presented. The theory is applied to simultaneously Q-switched and mode-locked Nd:YAG lasers and good agreement between theory and experiment is obtained. The main conclusion is that under usual Q-switched operating conditions the mode-locking process does not have sufficient time to build up to steady-state conditions. Also presented is a method to overcome this problem by allowing the laser to prelase before the Q-switch is opened. Mode-locked pulses whose width approaches the steady-state value are obtained. The transient mode-locking theory presented here

also applies to actively mode-locking TEA CO_2 lasers and to other types of simultaneously pulsed and mode-locked lasers. (auth)

15307 INSTABILITY OF A THREE-MODE GAS LASER WITH A SYMMETRICAL FREQUENCY CONFIGURATION. Zeiger, S. G. (Leningrad State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 832-833(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1308-1310(Jun 1973).

The stability of steady-state three-mode regimes with symmetrical mode frequencies in a standing wave laser is investigated using the Lamb equations with refined coefficients, which are valid for arbitrary ratios $\Delta\omega/\gamma$, γ/γ_{ab} ($\Delta\omega$ is the mode frequency spacing, γ is the level width, and γ_{ab} is the linewidth for a single atom). It is shown that there is a range of pumping levels in which both three-mode regimes are unstable: the regime in which the beats occur in phase ($\varphi = 0$), and the regime with antiphase beats ($\varphi = \pi$). In this region the generation is nonstationary: The beat phase difference and the intensity difference of the side modes must pulsate. The magnitude of the instability region is calculated, and it is shown that with increasing pressure this region shifts toward higher pumping levels, so that at high pressures the regime is stationary over the entire range of three-mode generation. (auth)

15308 CONTROLLED-LENGTH MICROSECOND PULSES IN A RUBY LASER. Balashov, I. F.; Berenberg, V. A.; Ermakov, B. A. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 7, 964-967(Jan 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 7, 1523-1529(Jul 1973).

An analysis is made of the conditions for obtaining rectangular microsecond radiation pulses in a laser in which the losses are controlled and in which negative feedback is employed. Experimental results are given for a ruby laser with electronic control of the shape and length of microsecond radiation pulses. (auth)

15309 LASER WITH A GRID MIRROR. Anan'ev, Yu. A.; Grishmanova, N. I.; Sventsitskaya, N. A. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 7, 968-971(Jan 1974).

Translated from Zh. Tekh. Fiz.; 43: No. 7, 1530-1536(Jul 1973).

The possibility of replacing the semitransparent mirror of a plane resonator by a grid is analyzed. Experimental results for a laser with a highly uniform medium (neodymium glass) are reported. (auth)

15310 PRESENT STATUS OF PUMPING METHODS OF LASERS USING NUCLEAR REACTIONS. Hirano, T. (Defense Academy, Yokosuka, Japan). Nippon Genshiryoku Gakkaishi; 15: No. 10, 661-666(Oct 1973). (In Japanese).

A review is presented, which summarizes both experimental and theoretical studies reported during the nine-year period 1964-1973 on pumping methods for lasers using nuclear reactions either with or without electrical discharge (nuclear pumped lasers or direct nuclear pumped lasers). In much of the reported experimental work, the $^{10}B(n,\alpha)^7Li$ and $^3He(n,p)^3H$ nuclear reactions have been utilized as sources for high-energy heavy particles with neutron fluxes ranging from 10^9 to 10^{17} n/cm^2 · sec. Most of the theoretical work has been focused on the calculation of threshold neutron flux requirements for noble gases or CO_2 lasers. The threshold estimates fall in the range $1.2 \times 10^9 \sim 10^{18}$ n/cm^2 · sec on ^{10}B. A theoretical model was proposed by Guyot et al. which predicts the behavior of the metastable densities in noble-gas plasmas created by nuclear radiations. A study of the electron energy distribution function in nuclear pumped lasers using the combined Boltzmann-Fokker-Planck equation is now underway. (auth)

15311 FORM AND DIRECTION OF THE EMISSION OF A LASER WITHOUT EXTERNAL RESONATOR. Glas, P. (Zentralinstitut fuer Optik und Spektroskopie, Berlin). Exp. Tech. Phys.; 21: No. 4, 299-315(1973). (In German).

The emission of a laser without any resonance structure was investigated when the diameter of the discharge tubes was changed and one single mirror was used. The divergence angle was measured for various geometries. The emission behavior changes drastically if the excitation energy is varied. Near threshold the emission occurs with approximately the same probability from one end of the discharge tube as from both ends. (auth)

15312 DESIGN OF GAS DYNAMIC CO_2 LASER. I. Amplification Factor. Krasitskaya, L. S.; Napartovich, A. P.; Sharkov, V. F. High Temp. (USSR) (Engl. Transl.); 11: No. 6, 1-12(1973).

Translated from Teplof. Vys. Temp.; 11: No. 6, 1155-1161 (1973).

The report discusses the problem of determining the amplification factor of a CO_2 GDL. Results of calculations are presented in graphical form. (auth)

15313 STATISTICAL CHARACTERISTICS OF THE RADIATION OF A MULTIFREQUENCY LASER. Deryugin, I. A.; Kurashov, V. N.; Abdullaev, R. A.; Nastich, V. N. Bull. Acad. Sci. USSR, Phys. Ser. (Engl. Transl.); 37: No. 10, 87-91(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 10, 2115-2120(Oct 1973).

An investigation was made of the statistical properties of radiation for the intermediate case in which the number of excited modes does not exceed 10 and phase synchronization is insignificant or altogether absent. Individual photoemission events were counted and analyzed. Diagrams show the distribution of photo counts and longitudinal modes of oscillation along with correlation coefficients. (MOW)

15314 VORTEX-TYPE SOLUTIONS IN THE PROBLEM OF LASER SELF-FOCUSING. Moskalenko, S. A.; Sinyak, V. A.; Khadzhi, P. I. Bull. Acad. Sci. USSR, Phys. Ser. (Engl. Transl.); 37: No. 10, 120-122(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 10, 2152-2154(Oct 1973).

A nonuniform distribution in space of coherent excitons involved in the formation of a quantum vortex and in translational motion along its axis is considered. It is shown that if the dipole moment of the transition is parallel to the vortex axis, the electromagnetic wave that propagates along the axis is almost longitudinal with transverse field-strength components that are nonzero in the neighborhood of the core of the vortex and that decrease slowly with increasing distance from the axis. This phenomenon is analogous to the formation of light filaments. (auth)

15315 SELF-FLUSHING IMPULSE INJECTOR FOR RADIOTRACER MEASUREMENTS OF THE FLOW OF HYDROMIXTURES IN CLOSED CIRCUITS. Korbel, K. (Inst. of Nuclear Physics and Techniques, Krakow); Owsiak, T. (Nukleonika; 19: No. 4, 381-386(1974).

A technical description of a special injector for radiotracer experiments developed recently in the Nuclear Electronics Department at the Institute of Nuclear Physics and Techniques and the Department of Nuclear Physics Applications at the Institute of Nuclear Physics is given. This injector may be used for impulse injection of both liquid and solid tracer substances and is designed for experiments performed on the industrial pipe-lines of hydraulic conveying installations. (auth)

15316 BAND INVERSION IN $Pb_{1-x}Sn_xSe$ ALLOYS UNDER HYDROSTATIC PRESSURE. III. Laser Emission. Martinez, G. (CNRS, Paris). Phys. Rev., B; 8: No. 10, 4693-4707(15 Nov 1973).

Laser emission from PbSe and $Pb_{1-x}Sn_xSe$ diodes was investigated under hydrostatic pressures up to 15 kbar near liquid-nitrogen temperature. The dominant modes, as well as their spacing and their slope and the threshold current necessary to get laser action, have been studied under pressure, and by varying the carrier concentration of the diode substrates. The laser effect was observed on both sides of the band crossing on a single diode and it is shown that the laser effect is limited in energy to the value of the mixed plasmon-phonon oscillator. To interpret these experiments quantitatively, a model was developed for the laser action. In this model, the calculated dielectric constant of an inverted medium in the case of nonparabolic bands is used. The density of states signal tailing as well as the spontaneous- and simulated-emission rates in these salts are evaluated quantitatively. The agreement between theory and experiment is good before the band crossing point, but after it, discrepancies appear; these are analyzed. (auth)

15317 DEPENDENCE OF THE GENERATION POWER OF CO LASERS AT ROOM TEMPERATURE ON SEVERAL FACTORS. Pisarenko, V. V.; Lotkova, E. N. Zh. Prikl. Spektrosk.; 20: No. 5, 784-787(May 1974). (In Russian).

The generation power of electric discharge CO lasers powered by direct current with steady gas mixture and flow was studied as a function of the discharge current and composition, pressure, and flow rate of the mixture. Cooling of the gas-discharge tubes was achieved by flowing water. First without cooling by liquid nitrogen, generation was obtained in mixtures without the addition of Xe. The optimum discharge parameters for $CO-N_2-He-O_2$ (1 : 6.7 : 23 : 0.03) mixtures at $P_{tot} \approx 20.3$ torr were $i = 12$ mamp, $v = 15$ kV, and generation power of 1.5 W. The length of the discharge tube was 120 cm and the radiation output was produced through an aperture in resonator mirror. At currents <13 mamp the generation power in mixtures without Xe is higher than in mixtures with Xe. With increase of the flow rate of the mixture from 0.65 to 59 m/sec for both mixtures the power is increased 3.5 times. Generation was obtained in the sealed-off regime in mixtures with and without Xe. The generation power in the first case is 5 times higher than in the second. (tr-auth)

15318 EFFECT OF THE ANTI-STOKES DECREASE OF THE LUMINESCENT QUANTUM YIELD OF DYES ON THEIR LASER EFFICIENCY. Rubinov, A. N.; Kechkemeti, I.; Kozma, L.; Ezhova, L. P. Zh. Prikl. Spektrosk.; 20: No. 5, 810-813(May 1974). (In Russian).

The inactive absorption spectra in ethanol solutions of rhodamine 6Zh, rhodamine B_1 and fluorescene were calculated on the basis of experimental data on the anti-Stokes decrease of the luminescent quantum yield of dyes. In all cases the inactive absorption band is located in the region of the luminescent band of the dyes. An analysis was made of the effect of inactive absorption on the threshold, efficiency, and frequency of the generation of lasers based on these dyes. It was shown that in fluorescene and particularly in rhodamine B inactive absorption leads to a significant improvement of the energy characteristics and displacement of the generated radiation. (tr-auth)

15319 CHOICE AND TESTING OF MATERIALS USED IN THE CONSTRUCTION OF HIGH-TEMPERATURE SODIUM VALVES. Abramson, R. (CEN de Cadarache, Saint-Paul-les-Durance, France); Elie, X.; Nedelec, J.; Vercasson, M. Mecan. Mater. Elec.; No. 290, 3-6(Feb 1974). (In French).

Two incidents that occurred during tests on high temperature sodium valves are reported: rupture of sealing bellows due to seize-up and an incident that occurred with the Phenix steam generator at the Renardieres EDF center. The results emphasize the importance of the mechanical design of the valve, the choice of materials, and the conditions under which the valve is used. (FR)

15320 ATOMIC RADIATIONS: MASER AND LASER. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 71-102 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

As quantum systems, the atoms can be determined under certain conditions, to amplify and to "coordinate" their emission of electromagnetic radiations by using the principle on which the generators and amplifiers of the laser and maser type are based. The cold plasma ($T < 10^5$ °K) exhibiting remarkable practical applications are studied. Further, the quantum generators and amplifiers, as well as other masers and lasers together with their working principles are also presented. (INIS)

15321 TWO-ANODE $He-Cd^+$ LASER. Miseraczyk, J.; Konieczka, J. (Inst. of Fluid-Flow Machines, Danzig). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 22: No. 3, 237-238(1974).

The two-anode $He-Cd^+$ laser is described and the optimum operating conditions are reported. The maximum of laser power can easily be obtained by proper adjustment of the discharge currents of both anodes. (auth)

15322 SELF-CONTAINED ASPIRATION INSTALLATION FOR SAMPLING RADIOACTIVE AEROSOLS IN AIR. Maslovskii, R. Ya. Gig. Sanit.; No. 1, 70-71(Jan 1974). (In Russian).

The design and operation of an aerosol sampling installation operating on its own battery or from an automobile battery is described. (JSR)

Heat Transfer and Fluid Flow

Refer also to abstracts 15288, 15360, 17705, 17709, 17840, 17841, 17846 and 17929.

15323 (AREAEE-185) EXPERIMENTAL DETERMINATION OF THE NUSSELT NUMBER FOR THE CASE OF AN EXPONENTIALLY INCREASING WALL HEAT FLUX IN THE FLOW DIRECTION. Gaddis, E. S.; Rizk, M. F. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 14p. Dep. NTIS (US Sales Only) $4.00.

An experimental apparatus was built to achieve a wall heat flux which increases exponentially in the direction of the fluid flow. The Nusselt number for this thermal boundary condition was measured from the experiments and compared with the Nusselt number for the case when the wall heat flux is uniform in the flow direction. The Nusselt number for the first case was higher than for the second for the range of Reynolds number covered in the experiments. (auth)

15324 (AREAEE-186) EFFECT OF CONDUCTION ON THE EQUILIBRIUM OF A VAPOR BUBBLE ON A HEATED SOLID SURFACE IN THE PRESENCE OF A FORCED FLOW. Gaddis, E. S. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 14p. Dep. NTIS (US Sales Only) $4.00.

A model is presented to examine the importance of conduction around an equilibrium vapor bubble in the presence of a forced flow. The model shows that conduction cannot be ignored in computing the vapor temperature necessary for thermodynamic equilibrium. (auth)

15325 (AREAEE-189) ANALYSIS OF NONSYMMETRIC DOUBLE PASS HEAT EXCHANGERS WITH NONEQUAL OVERALL COEFFICIENTS OF HEAT TRANSFER. Abdel Rahman, F. M.; Darwish, M. A.; El-Saiedi, A. F. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 12p. Dep. NTIS (US Sales Only $4.00.

A modified method for thermal analysis of shell-tube heat exchanger having non-equal tube passes is presented. In a previous report the analysis was made using one constant overall heat transfer coefficient for both tube passes. Here, a heat transfer coefficient is taken for each pass. The analysis leads to formulas giving the exchanger effectiveness as a function of the number of transfer units, and the heat capacity ratio of the hot and cold fluids. A formula is also presented for calculating the correction factor required for thermal calculations of such exchangers. (auth)

15326 INTERACTIVE MINICOMPUTER-AIDED DEMONSTRATIONS OF THERMODYNAMIC CYCLE CHARACTERISTICS. Carlson, R. W.; Rust, J. H.; Harmer, D. S.; Wrege, D. E. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 18: 31 (Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, Pennsylvania (23 Jun 1974).

15327 APPLICATION OF THE STABILIZED MARCH TECHNIQUE TO A NONLINEAR PROBLEM OF FLUID FLOW. Riehm, P. F.; Lucey, J. W. (Univ. of Notre Dame, IN). Trans. Amer. Nucl. Soc.; 18: 133-134(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15328 ADVANCES IN HEAT TRANSFER. Volume 10. Hartnett, J. P.; Irvine, T. F. Jr. New York; Academic Press, Inc. (1974). 311p. $32.00.

Review articles or monographs on special topics of current interest in the field of heat transfer are presented. Included in this volume is information on the thermophysical properties of lunar materials from the Apollo missions; heat transfer within the lunar surface layer; boiling nucleation; heat transfer in fluidized beds; and heat and mass transfer in fire research. (LCL)

15329 CALCULATING THE TEMPERATURE FIELD FOR A HOLLOW CYLINDER WITH INTERNAL HEAT SOURCES DURING COOLING BY TWO-PHASE LAMINAR FLOW. Butuzov, A. L; Tomkunas, V. I. Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 95-100(1972). (In Russian).

A method is proposed for the approximate thermal calculation of a hollow cylinder having internal heat sources and cooled by a two-phase laminar flow. Formulas are presented for calculating the change in cylinder temperature along its length and middle, and also the change in superheat along the perimeter of the part of the channel not washed by liquid compared to the part touched by liquid. (SJR)

15330 PROCEEDINGS OF THE 1974 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE HELD AT CORVALLIS, OREGON, JUNE 12-14, 1974. Davis, L. R.; Wilson, R. E. (eds.). Stanford, CA; Standord University Press (1974). 374p. (CONF-740613-). $17.50.

Papers on various aspects of heat transfer including annular flow, boiling, heat pipes, separated flows, turbulent flows, natural convection, unsteady multidimensional flows, fluid mechanics, thermal plumes, and modeling of planetary boundary layer. A separate abstract was prepared for one paper. (MCG)

For an abstract of an individual paper see: 15530.

15331 HEAT TRANSFER IN THE LAMINAR FLOW OF RADIANT MEDIUM BY UNIFORM HEAT FLUX HEATING. Hasegawa, O. (Kyushu Univ., Fukuoka); Echigo, R.; Tani, Y. Nippon Kikai Gakkai Rombunshu; 39: No. 321, 1628-1634(May 1973). (In Japanese).

The effect of radiant heat transfer on other heat transfer mechanisms is discussed with regard to high temperature radiant media such as carbon dioxide gas, steam etc. The theoretical analysis is reported of heat transfer in the preliminary flow region, where developed velocity distribution and undeveloped temperature distribution exist, for flow between the parallel plates of infinite width and with constant heat flux. The results of the analysis are compared with the heat transfer by convection considering only the effect of radiant heat transfer on wall temperature change, temperature distribution of flow, and the Nusselt number. By approximating the radiation damping function as a one-dimensional function, the following results were obtained. With radiant heat transfer, the wall temperature gradient in the flow direction is smaller than the mixed average temperature gradient downstream, so that the so-called asymptotic Nusselt number does not

exist. The wall temperature rise due to radiant heat transfer can be held low as compared with the wall temperature rise due to convection heat transfer. As the optical thickness becomes too large, the wall temperature increases further due to the phenomenon of radiation shielding effect. Under heat transfer with high inlet temperature or high heat flux, the effect of radiant heat transfer becomes increasingly important. (JA)

15332 ANALYSIS OF TRANSIENT HEAT TRANSFER FOR TURBULENT FLOW IN ANNULI. I. Heating Element With a Finite Thermal Capacity and No Thermal Resistance. Kawamura, H. (Japan Atomic Energy Research Inst., Tokai). Nippon Kikai Gakkai Rombunshu; 39: No. 324, 2498-2511(Aug 1973). (In Japanese).

A basic analysis of the transient heat transfer from a heating unit with heat capacity to turbulent flow in annuli was performed. A model was employed, in which the thoroughly developed turbulent flow in annuli was heated from an inner tube. The mathematical model of transient heat transfer was developed, the approximate analytical solution of transient heat transfer was calculated, and the effect of each parameter on heat transfer rate was investigated. In the region of $t \leq x/(4u_i^*)$, the time-dependent characteristics of heat transfer rate agreed with the solution of heat conduction. The analytical solution of transient heat conduction to turbulent flow explained in detail the transient change characteristics of heat transfer rate. The parameter β relevant to the heat capacity of a heating unit was derived. The initial temperature rise on heat transfer surfaces was determined by the heat capacity of the heat transfer surface in region of $\beta \geqq 1$, and was determined by heat conduction to be $\beta \leqq 1$. At the early stage, the heat flux and the heat transferred to the fluid require the transient analysis of heat transfer unless $\beta = 0$. Using the analytical solution of heat transfer rate, transient heat transfer characteristics can be calculated by solving a one-dimensional energy equation. (JA)

15333 ANALYSIS OF BOILING HEAT TRANSFER ON A FIN. Takeyama, T. (Tohoku Univ., Sendi); Endo, T.; Owada, K. Nippon Kikai Gakkai Rombunshu; 39: No. 325, 2835-2841(Sep 1973). (In Japanese).

When temperature is raised enough to cause film boiling at the root of a fin placed in a liquid, mixed boiling heat transfer occurs, in which film boiling, transient boiling, nucleate boiling and convection coexist side by side from the root to the tip of the fin. Under the assumption that the heat transfer rate obeys the power rule, mixed boiling curves, i.e., the relation between transferred heat quantity and the temperature at the root of the fin, are numerically estimated. The calculated mixed boiling curves agreed in tendency with the boiling curve by Runge-Kutta method employing the heat transfer rate faithful to Haley's boiling curve, but showed $1/3$ to $1/10$ the quantity of heat transferred as compared with results calculated from the latter curve. However, the experimental values of full film boiling were much smaller than the above calculated values. This fact suggests that the heat transfer rate is significantly affected by the form of the fin and the temperature distribution. Unless a local heat transfer rate is employed which takes account of the form, position and temperature distribution of fin surface, it may be difficult to make the calculated values consistent with the experimental values. (JA)

15334 ADIABATNYE DVUKHFAZNYE TECHENIIA. (Adiabatic Two-Phase Flows). Tsiklauri, G. V.; Danilin, V. S.; Seleznev, L. I. Moscow; Atomizdat (1973). 448p. (In Russian).

The theoretical and applied problems of the gasdynamics of two-phase media are discussed with particular attention to high-speed adiabatic flows and jets. Expressions of energy conservation are derived for a two-phase fluid flow in the event of nonequilibrium interphase impulse, heat, and mass transfers and exchanges. The physical characteristics of two-phase flows of different structures in nozzles, pipes, curvilinear channels, and jet systems are discussed. Critical effects, the formation of shock waves and condensation inhomogeneities, and other transients in two-phase fluid flows are analyzed. (IAA)

15335 DYNAMIC BEHAVIOR OF CYLINDRICAL STRUCTURES IN AXIAL FLOW. Paidoussis, M. P. (McGill Univ., Montreal). Ann. Nucl. Sci. Eng.; 1: No. 2, 83-106(Feb 1974).

The effect of axial flow on cylindrical structures is reviewed. It is shown that axial flow may cause fluidelastic instabilities at sufficiently high flow velocities. However, for the range of flow velocities and other parameters pertaining to most industrial systems, the effect of purely axial, uniform, steady flow is to damp free motions. Nevertheless, departures from such ideal flow conditions induce small amplitude vibration, termed subcritical vibration. The underlying mechanism of this vibration is examined, and the various means available for predicting its amplitude are discussed. The latter are either empirical or analytical (generally semi-empirical); the analytical methods are further classified into three categories accordingly as they postulate the vibration to be forced, parametric, or self-excited. The measure of success achieved in predicting subcritical vibration amplitude is discussed, and possible reasons for its being generally poor. At present, the amplitude may be predicted typically to within one order of magnitude. (auth)

15336 HEAT TRANSFER FROM BUNDLES OF HORIZONTAL CYLINDERS IN SATURATED WATER IN POOL BOILING CONDITIONS. de Martin Bonato, L.; Fontana, D. M. (Univ., Genoa). Termotecnica (Milan); 28: No. 5, 234-244(May 1974). (In Italian).

An experimental study was performed on the heat transfer from bundles of horizontal cylinders in saturated water under pool boiling conditions. The rod lattice is a square-mesh rectangular array, with 4 vertical rows and 2 to 10 horizontal rows. The pitch ranges from 3 to 12 mm; the rod diameter is 2 or 4 mm. The effect of unpowered vertical lateral rows of rods, working as a guard, was also studied. It was found that the bundle arrangement does not reduce the exchange coefficients: on the contrary, an increase in heat exchange coefficients was observed at low heat fluxes ($q < 30$ W/cm^2). The critical heat fluxes were chiefly affected by the pitch values, e.g., for large pitch, q_{cr} is about the same as that for single rod and independent of the characteristics of the lattice; for small pitches, q_{cr} is a decreasing function of the number of vertical rows. (auth)

15337 INTERPRETATION AND CORRELATION OF DEVIATIONS FROM A HYDRODYNAMIC CHANNEL BOILING THEORY OF DATA ON NITROGEN AND HYDROGEN IN FORCED AND FREE FLOWING BOILING. Sydoriak, S. G. (Los Alamos Scientific Lab., NM). LA-DC-72-260. Advan. Cryog. Eng.; 18: 73-80 ([nd]).

Channel boiling data of three laboratories were compared to predictions of a rigorous hydrodynamic theory based on the assumptions that the flow is frictionless and homogeneous. At high flow rates, areas of excellent agreement (within 5%) are noted in graphical correlations of nucleate and film boiling of nitrogen and hydrogen, in support of the theoretical assumptions; i.e., essentially all of the available potential energy was converted to kinetic energy; little if any being lost to frictional effects or physical separation of the phases. Where agreement was not as good, the qualitative dependence on flow rate and channel cross section was again consistent with the theoretical assumptions, the indication being that static bubbles or film attached to the heated wall was responsible for the observed deivations from theory. At low velocity, the apparent thickness of the static layer is 0.011 cm for liquid nitrogen and 0.013 cm for liquid hydrogen. These results raise a question as to the physical significance of possible incorporation of Borishanskii's viscosity correction factor into the Kutateladze–Zuber pool boiling equation. If channel boiling is ever frictionless, it would seem that boiling at an unconfined surface should also be frictionless. (LCL)

15338 MOTION OF A COMPRESSIBLE PLATE DRIVEN BY SHOCK OR DETONATION. Rivard, W. C.; Engelke, R. (Los Alamos Scientific Lab., NM). Quart. Appl. Math.; 29-44(Apr 1974). (LA-DC-72-908).

The method of characteristics is used to obtain solutions for the time-dependent motion of a compressible plate driven by a one-dimensional shock or detonation followed by a constant state. The plate can either move in contact with or separate from the driver, depending on the values of the initial parameters. The motion of the surfaces is described by a system of linear, first-order, ordinary differential equations in one independent variable. The interior waves and interactions are determined from the surface motions. The equation of state of the plate has the form described by Murnaghan, specialized to produce straight characteristics in the x, t plane. The equation of state for the driver is arbitrary. Closed-form solutions are obtained for the surfaces during their first reverberations for particular driver equations of state. Numerical examples are given which closely represent real systems. The results can be used as standards for finite-difference calculations. (auth)

15339 MOTION OF AN EXPLOSIVE-INDUCED PLANE SHOCK WAVE. Fickett, W. (Los Alamos Scientific Lab., NM). Quart. Appl. Math.; 71-84(Apr 1974). (LA-DC-72-1150).

A plane, unsupported, Chapman-Jouguet detonation in a condensed explosive drives a decelerating shock into a semi-infinite inert of lower shock impedance. A previously reported exact solution for a portion of this one-dimensional time-dependent problem is extended to the entire flow field, and some numerical results are given. The solution has the form of a small set of first-order ordinary differential equations for the shock, and a similar set for each particle path. (auth)

15340 SIMULATION USING COMPUTER MODEL ON THE NUCLEATE BOILING PHENOMENON. I. Yamagishi, H.; Hanaoka, Y. (Muroran Inst. of Tech., Hokkaido, Japan). Muroran

Kogyo Daigaku Kenkyu Hokoku; 8: No. 1, 19-27(Oct 1973). (In Japanese).

Many workers have offered various useful theoretical and experimental results in nucleate boiling study. These results are reconfirmed by the fact that the nucleate boiling phenomenon can be simulated in arbitrary conditions. An attempt is made to simulate nucleate boiling by computer model based on experimental results. Generally, nucleate boiling is successive in many linkage cycles, each cycle being composed of bubble generation-growth-departure-waiting-generation. Data obtained up to the present day by investigators have been applied to each stage. The effect of the separation of the thermal boundary layer by agitation of bubbles is neglected, and the modified Jacob's relation, fd_0 = constant, is applied to the check of present results. Relative to the increasing or decreasing heat flux, the present value of the constant tends to deviate from the one by other investigators. It seemed to depend mainly on the treatment of coalescence of growing bubbles and the waiting period. Therefore, the present simulation model needs to be refined. (auth)

Materials Testing

Refer also to abstracts 15738 and 16235.

15341 (CONF-700347-, pp vp, Paper 23) SIMULATED SERVICE TEST ACTIVITY. Robinson, G. C. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The Simulated Service Task has as its primary objective the demonstration of the capability of predicting failure load and condition of failure of full-size pressure vessels. This capability is to be achieved in this task by means of a series of tests which will be founded on the data and technology developed in the previous tasks. The tests will be performed sequentially in increasing complexity of conditions investigated. At each stage an analysis and comparison will be made of the various failure theories which have been hypothesized to apply. Hopefully, the limits of applicability of the various theoretical and empirical approaches will be established in order to provide input to the applicable standards, codes, and regulations. (auth)

15342 (CONF-700347-, pp vp, Paper 31) GENERAL REVIEW OF THE STATUS OF THE EEI-TVA RESEARCH PROGRAM ON INSERVICE INSPECTION. Wylie, R. D. (Southwest Research Inst., San Antonio). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The Edison Electric Institute–Tennessee Valley Authority research program has been previously described. The objective of the program is to evaluate potential techniques which may be applicable to in-service inspection of reactor pressure vessels. It is presently planned to evaluate these techniques both in the laboratory and in the field by using the Experimental Beryllium Oxide Reactor facility at the National Reactor Test Site in Idaho. This facility has been decommissioned and will be provided to the project by the Atomic Energy Commission. The program originally included work on acoustic emission procedures, the acoustic spectrometer, and improved ultrasonic systems. After the first phase of study, work has been discontinued on the acoustic spectrometer. An acoustic emission system has been constructed and is ready for laboratory evaluations. Work is proceeding on studying the influence of cladding on defect detection and discrimination by conventional ultrasonics. Studies are also in progress on the influence of the reactor environment on the reproducibility of ultrasonic signals as influenced by crud deposits or neutron irradiation. A new project has been initiated on acoustic holography as a tool for in-service inspection of reactor components. (auth)

15343 (CONF-700347-, pp vp, Paper 32) POTENTIALS OF ACOUSTIC HOLOGRAPHY FOR NON-DESTRUCTIVE TESTING. Worlton, D. C. (Jersey Nuclear Co., Richland, WA). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Recent advances in acoustic holography suggest this method may become a practical new nondestructive testing technique. It has now been clearly demonstrated that internal defects in metals can be visually imaged ultrasonically by use of holographic principles. These images show defect size and shape, and therefore may more completely characterize the nature of defects than is possible with existing ultrasonic test methods. One ultrasonic holographic test method illuminates the defects to be imaged using a send transducer; the waves radiated from the defects are scanned using a small receiver transducer. The detected signals are mixed with an electronic reference beam and then used to modulate the intensity of a small light bulk translated in spatial correspondence with the scanning transducer. This light exposes a photographic film. After development, the film is a hologram whose illumination with a coherent light beam reconstructs a visible image of the defects. It is immaterial whether the illuminator or receiver transducer is scanned, and it is possible to mechanically fix the two tranducers together so they can be scanned as a single unit. This technique is described in detail and results shown of applying it to obtain visible images of natural and artificial defects in thick aluminum and steel test blocks. Its potential use as a practical test method applicable to field conditions, as would be encountered in inspection of a reactor pressure vessel, for example, is also discussed. Another ultrasonic holographic method is used to transilluminate the test object by an ultrasonic beam which is also directed upward such that it strikes the surface of a liquid. A second ultrasonic beam is also directed at the surface. Acoustic pressure of the two beams displaces the liquid surface a small amount. The resultant ripple pattern is a hologram which may be illuminated with a light beam to reconstruct defects situated in the test block. This technique has the advantages of real-time imaging. This system is discussed. The real-time feature is demonstrated using a motion picture which shows a fish swimming in a tank of water while its internal structure is displayed on a TV screen. (auth)

15344 (CONF-700347-, pp vp, Paper 34) AUTOMATED TECHNIQUES FOR ULTRASONIC SCANNING AS APPLIED TO INSERVICE INSPECTION. Lautzenheiser, C. E. (Southwest Research Inst., San Antonio). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Radiation levels and the need for reproducible examinations require automated techniques for in-service inspection of nuclear systems. A review is given of the automated equipment that has been used for in-service inspection of civilian reactors in the United States, such as Elk River, and in Europe, such as Garigliano and Trino Vercellese. A detailed description is given of automated equipment currently being used for preservice inspection, and its applicability to in-service inspection is discussed. (auth)

15345 (INIS-mf-976) METALLURGICAL CHARACTERIZATION OF TUBES FOR FUEL ELEMENTS. Fizzotti, X.; Sala, L.; Traversi, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Oct 1972. 17p. INIS.

From 2nd Italian–Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

The report describes and discusses the methods used to inspect and characterize cladding tubes, e.g., dimensional controls, nondestructive controls, mechanical controls, structural controls, and corrosion controls. These controls allow characterization from a metallurgical point of view the tubes to be used as cladding for fuel element fabrication. These controls, as it has been demonstrated by irradiation and in-loop experiments, are available. (INIS)

15346 (NP-20015) DETERMINATION OF SUBPLATING CRACKS WITH THE HELP OF SOUND EMISSION ANALYSIS. Progress Report. (Battelle-Institut e. V., Frankfurt am Main (F. R. Germany)). Oct 1972. 57p. (In German). Dep. NTIS (US Sales Only) $6.00.

The results obtained on the use of sound emission analysis for the detection of subplate weld cracks in 22NiMoCr37 steel were reported and compared with the theoretical predictions. The formation of subplate cracks was also detected in BHW38 steel (a high-V variation of the original steel). Noise sound analysis showed that these crack formations, in contrast to that in 22NiMoCr37 steel, occurred during the heating of the sample. Possible reasons for this were discussed. (JSR)

15347 (NP-20016) DETERMINATION OF SUBPLATING CRACKS WITH THE HELP OF SOUND EMISSION ANALYSIS. Progress Report. (Battelle-Institut e.V., Frankfurt am Main (F.R. Germany)). Apr 1973. 37p. (In German). Dep. NTIS (US Sales Only) $5.00.

Laboratory studies on low-stress anneal of plated reactor steel 22NiMoCr37 have shown that noise emission analysis is suitable as a nondestructive method for the detection of subplate cracks. The extent of the crack formation can be determined qualitatively with a noise emission parameter that sums the pulse rate over the anneal duration. The method therefore permits a coarse classification of the fissures by size and frequency. The studies showed that a minimum length of the subplate crack of 1 mm corresponds to a control value of 4×10^6 for the sum of the pulse rates. Sound emission analysis shows the kinetics of the crack formation as a function of the anneal duration and the anneal temperature. The formation or growth rate of the cracks reaches a maximum at a certain incubation period and then continuously decreases

even with subsequent anneal. These results agree with theoretical results on the appearance of subplate cracks. The origin and the mechanism for the formation of subplate cracks were determined. (tr-auth)

15348 RADIOGRAPHIC IMAGE RESOLUTION BASED ON EDGE-SPREAD FUNCTION ANALYSIS. Harms, A. A.; Garside, B. K. (McMaster Univ., Hamilton, Ontario). Trans. Amer. Nucl. Soc.; 18: 62-63(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15349 TRACK ETCH HEAVY-PARTICLE RADIOGRAPHY. Benton, E. V. (Univ. of San Francisco); Henke, R. P.; Tobias, C. A. Trans. Amer. Nucl. Soc.; 18: 82-83(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15350 PHOTON ACTIVATION OF MATERIALS SUBJECTED TO BETATRON RADIOGRAPHY. Kuttemperoor, V. Z. (Milwaukee School of Engineering). Mater. Eval.; 32: No. 7, 153-156 (Jul 1974).

Materials that have been radiographed using a 25-MeV betatron were analyzed for gamma radiation using a high resolution nuclear spectroscopy system. Nuclear spectra of the radiographed material accumulated at different times after exposure show the presence of both short-lived and long-lived isotopes in the activated material. Decay curves of the activated materials are presented that show the initial level of activity produced by various amounts of exposure and the subsequent decay rate of the activated materials. The source of the major activity contributing to the short half-life of the activated materials has been identified as ^{56}Mn and ^{24}Na, and the source of the major activity responsible for the long half-life has been identified as ^{57}Ni, ^{57}Co, ^{51}Cr, and ^{203}Pb. The radioactivity of the material after radiography is explained on the basis of the creation of several isotopes which resulted from different photonuclear reactions that took place in the material during exposure. The analysis presented clearly shows that materials that have been radiographed using a 25-MeV betatron become radioactive. The health hazards associated with the observed radioactivity are pointed out. (auth)

15351 NEUTRON RADIOGRAPHY AS A TOOL FOR CADMIUM DISTRIBUTION MEASUREMENTS IN $Hg_{1-x}Cd_xTe$ SINGLE CRYSTALS. Gasparrini, G.; Mangialajo, M.; Passoni, D.; Pirovano, B. (Centro Informazioni Studi Esperienze, Milan). Infrared Phys.; 14: No. 2, 145-149(May 1974).

Neutron radiography as applied to the determination of cadmium content in $Hg_{1-x}Cd_xTe$ is described. This technique, in addition to a reasonable sensitivity and spatial resolution, allows a visual estimate of cadmium distribution. In the range $0.19 \leq x \leq 0.24$, composition measurements with an overall uncertainty Δx less than 0.01 and spatial resolution better than 150 μm may be performed. Capabilities of the method to study the parameters affecting the growth of crystals suitable for infrared detection are shown. (auth)

15352 METHOD OF MAKING RADIOGRAPHS. Newman, G. A. (to Kodak Ltd.). British Patent 1,347,671. 20 Feb 1974. Filed date 26 Mar 1970. 2p.

In conventional ways of making x-ray radiographs it is necessary to keep the sensitive material in a light-proof container until the processing stage, and this may be inconvenient especially in industrial radiography. In the method described thermoluminescence is employed. The thermoluminescent material after exposure to x-rays releases its absorbed energy below 150°C and is tested in the dark in contact with a photographic halide emulsion layer, followed by processing to give the desired radiograph. It is preferable to use a material that will release its absorbed energy in the temperature range 70 to 90°C. The recording material can be reused since after energy release it is restored to its original condition. Examples are given of the preparation and use of the materials. (UK)

15353 X-RAY SENSITIVE IMAGE STORAGE PANEL. Ranby, P. W. Radiography; 40: No. 474, 119-127(Jun 1974).

From 27th annual conference of the Society of Radiographers; Bournemouth, Eng. (May 1973).

The development of x-ray sensitive image storage panels from electro-luminescent lamps is described. A special form of zinc oxide has been found to become photoconducting when exposed to x rays but not when exposed to light. The zinc oxide retains its conductivity for quite long periods of time. The zinc oxide coupled with an electroluminescent layer will continue to glow after the x rays are switched off. The properties of the panel are described, and various requirements needed to give it a useful role in radiography are given. (UK)

15354 ORIGINAL APPLICATION OF NEUTRON-RADIOGRAPHY: IN SITU INVESTIGATION OF ROOT DEVELOPMENT. Couchat, Ph.; Moutonnet, P. (CEA, Saint-Paul-lez-Durance, France). pp 313-325 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The technique of neutron radiography, which ten years ago was used in only a few laboratories, has since then undergone considerable development. At the same time, agronomists wishing to study the mechanisms of water absorption by roots have felt the need for a method of measuring the root population, preferably in situ, in terms of specific weight or specific area. The association of this problem and the new technique led to consideration of the possibilities of examining roots photographically in situ. Therefore neutron radiography was performed on columns of soil grown with maize. The high percentage of water present in the roots, and also the diffusion and the preferential absorption of neutrons by hydrogen nuclei, promised to make for good visualization of the roots in the soil and this was borne out by the results obtained. The equipment currently employed is heavy and expensive because it was not designed for the purpose; neutrons are produced by a freely developing chain reaction within a liquid fissile medium; since dysprosium is used as the converter, neutron radiography can be performed by the transfer method. The possible uses of an in situ device for measuring root development with a ^{252}Cf source and the so-called direct method involving the use of a gadolinium converter will be studied in the future. (auth)

Nuclear Explosions

15355 (AD-760460) COMPUTER PROGRAM FOR SIMULATING NUCLEAR BLAST LOADING PROFILES FOR CLOSED AND OPEN ELEMENT STRUCTURES. Schaeffel, J. A. Jr.; Griffin, J. R.; Eppes, R.; Pettey, R. H. (Army Missile Command, Redstone Arsenal, Ala. (USA)). 26 Dec 1972. 146p. (RL-72-15). NTIS.

The first stages in designing a computer program to simulate nuclear blast loading on closed box and open element structures such as might be found in fire control shelters, radar antennas, and other structures of various systems are reported. Much research into nuclear blast simulation was conducted. Fundamentally, the problem was to take a typical structure and through computer simulation, load it with a shock wave whose characteristics could be modeled mathematically. The program calculates the pressure and thermal loading profiles for a variety of typical aerospace structures. As a flexible tool, this program has amalgamated a variety of data into a compact unit which will serve as a useful device to the designer who is interested in failure criteria. The computer program, identification of the procedures for simulation, and other information required to use this blast and thermal loading program are presented. (auth)

15356 (JPRS-62166) CERTAIN RESULTS OBTAINED FROM EXPERIMENTAL NUCLEAR EXPLOSIONS OF INTERNAL EFFECT IN SALT DEPOSITS. Il'in, V. P.; Trofimov, V. D. Translated from Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 4, 74-78(1974). 8p. NTIS.

A brief outline and analysis of results from underground nuclear explosions in salt deposits, conducted in the USSR and the U. S. are presented with reference to the conditions involved in the development of salt deposits by the technique of underground leaching. (auth)

15357 (NVO-146) SUMMARY REPORT: AMCHITKA DEMOBILIZATION AND RESTORATION ACTIVITIES. (USAEC Nevada Operations Office, Las Vegas). Jun 1974. 55p. Dep. NTIS $5.75.

Following the November 1971 completion of underground nuclear explosion testing on Amchitka Island, activities commenced to restore the disturbed areas of the island to the condition they were in before the AEC use; prevent future environmental damage; minimize health and safety hazards; and improve both the areas used in the test programs and the buildings and sites which will remain on the island. These activities are described in detail and the results are illustrated with photographs. Finally, the long-term program for monitoring the radioactivity, seismicity, and geologic, hydrologic, and bioenvironmental conditions on the island is discussed. (LCL)

15358 (SC-TM-70-535) WINDOW DAMAGE STUDY OF THE LUBBOCK TORNADO. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Aug 1970. 20p. Dep. NTIS $4.00.

Window damages from the Lubbock tornado of May 11, 1970 were inspected in hopes of clarifying our concepts about the breaking of

windows by explosion waves, sonic booms, or wind gusts. There was no simple pattern of effects which could be established and extrapolated to low probabilities of damage. Breakage in upper levels of two high-rise office buildings gave indication of wind speeds of from 70 to 100 mph at 30 ft above ground, increasing to from 150 to 200 mph at 200 ft. Only the windows in upper floors appeared to be damaged by wind forces alone. Extensive breakage in lower floors appears to be caused mostly by missiles. Missile density (per unit volume of moving air) appears to be nearly constant over the first five floors, and then decreases exponentially with height, by three orders of magnitude at the 15th floor level. (auth)

15359 (TT-74-50011, pp 95-100) CALCULATION OF FRACTIONATION EFFECTS IN ATMOSPHERIC NUCLEAR BURSTS. Izrael, Yu. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A theoretical calculation is given of the coefficients of fractionation of radioactive isotopes in aerosols, formed during nuclear bursts. The calculations are conducted on the assumption of thermodynamic equilibrium between the liquid and gaseous fractions with the utilization of Raoult's law. The results are given of the calculation of the fraction of radioactive isotopes of the most important mass chains condensing on the aerosols as a function of the time after the burst. Also calculated are the coefficients of fractionation $f_{j\,,g}$ for the isotopes ^{132}Te, ^{90}Sr, ^{89}Sr and ^{137}Cs in the form of functions of particle radius (the time of particle solidification is 7 sec). The calculations are performed for the nearest trace of the surface blast. The derived theoretical correlation curve of fractionation of the series of isotopes agrees satisfactorily with measurements of isotope fractionation at the nearest trace of the "Small Boy" low-strength American nuclear explosion. (auth)

15360 (UCID-15914) TRANSIENT COMPRESSIBLE FLOW IN POROUS MEDIA. Morrison, F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Aug 1971. 91p. Dep. NTIS $7.75.

Transient compressible flow in porous media is treated analytically. Ideal gas flow is analyzed. The analysis includes the effects of heat transfer between the gas and the porous solid and may be applied to ideal gas flow from a nuclear cavity following an underground nuclear test. The results indicate that, despite the high cavity temperature, an isothermal model adequately predicts the pressure distribution for the period of primary interest. A nonisothermal analysis is necessary, however, to describe steam flow with phase changes. Radial isothermal flow of an ideal gas in cylindrical and spherical geometries is analyzed. Programs were written to describe transient radial flows with impervious outer boundaries or outer surfaces open to the atmosphere. Two-phase–two-component flow is analyzed. A program is developed to predict the behavior of the transient flow of steam-water-air mixtures through a porous column. The analysis includes the effects of compressibility, relative permeability of the two phases, phase changes, heat transfer between fluid and solid, axial conduction, heat loss normal to the direction of flow, and flow due to gravity. (auth)

15361 (UCRL-51572) TIME DISTORTION IN NUCLEAR WAR. Gustavson, M. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Apr 1974. Contract W-7405-eng-48. 9p. Dep. NTIS $4.00.

Past considerations of nuclear war, particularly those involving battlefield use, have not taken into account a major factor: the time-dependent nature of the human body's response to radiation. This factor is likely to introduce changes in the temporal nature of warfare as profound as the spatial changes associated with the increased explosive power of nuclear munitions. High fatality rates will last for days following a nuclear event and must be taken into account. Continued lack of attention to this aspect of nuclear warfare is likely to result in inappropriate choices of military posture, doctrine, and equipment. (auth)

Protective Structures and Equipment

15362 (LA-5620-PR) RESPIRATORY STUDIES FOR THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH, JULY 1, 1972 THROUGH JUNE 3, 1973. Hyatt, E. C.; Pritchard, J. A.; Held, B. J. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 45p. Dep. NTIS $4.00.

Progress is reported on research and development activities performed during FY 1973 by the Respirator Research and Development Section, Industrial Hygiene Group of the Los Alamos Scientific Laboratory (LASL) under an interagency agreement between the National Institute for Occupational Safety and Health (NIOSH) and the Atomic Energy Commission. The work was done at LASL and was a continuation of the services performed for NIOSH by the AEC under an FY 1972 interagency agreement. As requested in the FY 1973 interagency agreement, the efforts were concentrated in three major areas: the development of quality control test methods and the correlation of these test methods with the present respirator approval tests in order to provide improved quality control test methods for use by respirator manufacturers and NIOSH; the design, construction, and delivery of respirator test equipment for the performance of quality control tests to the NIOSH Testing and Certification Laboratory at Morgantown, West Virginia; and to the NIOSH Engineering Laboratory at Cincinnati, Ohio; and the development respirator test methods. (auth)

15363 (LA-UR-74-992) TEST METHODS AND EFFICIENCY STUDIES ON MULTI-BANK HEPA FILTER SYSTEMS. Ettinger, H. J.; Mitchell, R. N.; Gonzales, M.; DeField, J. D.; Elder, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 56p. (CONF-740406-15). Dep. NTIS $6.00.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Multiple stages of high-efficiency particulate air (HEPA) filter banks to attain decontamination factors of 10^9 to 10^{12} are proposed for the LASL new plutonium facility. The AEC Design Criteria for New Plutonium Facilities requires that the filtration system shall be designed to allow reliable in-place testing and ease of replacement. The designs for a glove box filter and a four-stage process exhaust filter installation are shown and methods of in-place testing and filter replacement are discussed. While extensive test data are available to substantiate decontamination factors of at least 2×10^4 for individual HEPA filters against sub-micron laboratory test aerosols, such as DOP, quantitative data for the actual work situation involving plutonium aerosols were not available. A field sampling program provided general criteria defining plutonium aerosol size characteristics and activity concentrations from typical plutonium operations. Using laboratory-produced plutonium test aerosols with size characteristics similar to those defined by the field sampling program multiple HEPA filter systems were evaluated to provide quantitative data defining performance of successive stages of HEPA filters, and filter performance as a function of particle size. Test data show that the first and second HEPA filter each provide overall efficiencies in excess of 99.98%, while the third HEPA filter provides an average efficiency in excess of 99.8%. These performance levels exceed AEC requirements. Data defining performance of the first and second HEPA filters as a function of plutonium aerosol size show that HEPA filter efficiencies are in excess of 99.98% for sub-micron plutonium aerosols. (auth)

Vacuum Engineering

Refer also to abstract 16253.

ENVIRONMENTAL AND EARTH SCIENCES

15364 ENVIRONMENTAL IMPACT OF ELECTRICAL POWER GENERATION: NEW EDUCATIONAL MINICOURSE. Jester, W. A. (Pennsylvania State Univ., University Park); McDermott, J. J.; Witzig, W. F. Trans. Amer. Nucl. Soc.; 18: 31-32(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, Pennsylvania (23 Jun 1974).

15365 REALISM IN ENVIRONMENTAL TESTING AND CONTROL. Proceedings of the Institute of Environmental Sciences 19th Annual Technical Meeting, Anaheim, California, April 2–5, 1973. Mt. Prospect, IL; Institute of Environmental Sciences (1973). 532p. (CONF-730401-).

Eighty-four papers were presented. A separate abstract was prepared for each of 10 papers. The remaining 64 papers were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 15535–15537, 15587, 15732, 17488, 17632, and 17886–17888.

Minerals and Ores

Refer also to abstracts 15647 and 18024.

15366 (CONF-721018-(Vol.3), pp 1183-1189) RECENT DISCOVERY OF A PREHISTORIC NATURAL CHAIN REACTION IN GABON. Bussac, J. 1972. (In French).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Uranium minerals from the northern zone of Gabon were found to have abnormal concentrations of ^{235}U. There is also an abnormal distribution of the rare earths, particularly Nd. These abnormalities are explained by the occurrence of an extremely ancient spontaneously produced chain reaction in the uranium ore deposit. (JSR)

15367 THERMAL HISTORY OF SOUTH INDIA. Nagpaul, K. K. (Kurukshetra Univ., India); Mekta, P. P. Trans. Amer. Nucl. Soc.; 18: 88(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15368 GEOCHEMISTRY OF RARE ELEMENTS IN ALKALINE BASALTOIDS AND GABBROIDS OF TECTONO-MAGMATIC ACTIVATION STAGES OF THE SOUTHERN TIEN SHAN AND PAMIR. Mogarovskii, V. V.; Klimov, G. K.; Dmitriev, E. A.; Mel'nichenko, A. K. (Inst. of Geology, Dushanbe, USSR). Geokhimiya; No. 4, 514-520(Apr 1974). (In Russian).

Data on the geochemistry of Li, Rb, Cs, Tl, Sn, U, Th, B, F, K characterize three rock groups developed on the Southern Tien-Shan and Pamir: proper basaltoids, alkaline basaltoids-gabbroids and potassic alkaline rocks. The general regularity of the distribution of rare elements in these rocks consists in the direct connection of their contents with potassium and fluorine concentrations. It is assumed that the enrichment of alkaline-basaltoid rocks in potassium, rare elements and fluorine is chiefly connected with the depth of magma generation in the upper mantle. (auth)

Radioactive Effluents

Refer also to abstracts 14748, 15061, 15452, 15868, 15986, 16496, 17823, 17824, 17864, 17866, 17886, 17887, 18002, 18012, and 18013.

15369 (ORNL-tr-2824) EFFECT OF SOIL HEATING BY ^{238}Pu ON FIELD FAUNA. Krivolutskii, D. A.; Fedorova, M. N. Translated by Martha Gerrard from Zool. Zh.; 52: No. 4, 601-603(1973). 4p. Dep. NTIS $4.00.

Soil was uniformly sprayed with ^{239}Pu dissolved in nitric acid. The plots were then planted with wheat. Microfauna were taken from surface soil layers in the heated section and in a control area. Data are tabulated for numbers of insects, mites, spiders, annelids, nematodes, and centipedes in both areas. A sharp decrease was found in the number of soil organisms in the area heated with ^{238}Pu. (HLW)

15370 (ORO-2401-85) BODY BURDENS OF RADIOACTIVITY. Brill, A. B.; Parker, F. L.; Johnston, R. E. (Vanderbilt Univ., Nashville, Tenn. (USA)). 1971. Contract AT(40-1)-2401. 37p. (CONF-710670-1). Dep. NTIS $5.00.

From workshop on multiple factors in the causation of environmentally induced disease; Bethesda, Maryland, USA (14 Jun 1971).

A brief review is presented of the sources of radioactive materials to which the human population is exposed. The sources are enumerated with some discussion of the variation in exposures received by different population groups. To assess the overall level of hazard to the general population, the radiation dose is presented in terms of average annual genetically significant dose (GSD) and the predicted GSD from different sources of radioactive isotopes in the year 2000 is included. It is pointed out that the hazard associated with these exposures is difficult to establish with certainty. Information concerning ^{131}I, which in large doses is known to produce deleterious effects in man, is summarized because of its medical and environmental importance and because so much is known about the radiobiological effects of this agent. Some of the factors which mediate radiation effects, i.e. saturation of body pools, dose distributions, co-factor interactions, and subject age, are discussed. (CH)

15371 (UCD-472-120, pp 8-15) COMPARISON SCALES FOR RADIOACTIVE AND NONRADIOACTIVE HAZARDS. Goldman, M. Jun 1973.

In annual report, fiscal year 1973.

Assessment of health hazards associated with energy production demands a balance between engineering source terms, to describe and quantitate effluents and emissions, and biomedical predictions. Nuclear power stations are required to keep radiation emissions as low as practicable (< 10 mrem/year). A linear dose-effect proportionality is prudently assumed and radiation risks to population groups are scaled in units such as excess expectation of health effects per 10^6 people/year/unit dose (rem). For non-nuclear pollutants, a risk analogous to a man-rem concept does not yet exist. Safety standards for alternate energy sources lack the dose-effect quantification needed for extrapolation of health effects per watt/person/year. Examples of risk estimates for current and future energy sources are presented with suggestions for health cost assessments and evaluations. (auth)

15372 EFFECTS ON AQUATIC BIOTA OF RADIOACTIVE EFFLUENTS FROM NUCLEAR POWER STATIONS. Blaylock, B. G. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 46-47(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15373 RADIOECOLOGICAL INVESTIGATIONS ON THE UPPER REACHES OF THE RIVER DANUBE. Hueber, K.; Ruf, M.; Herrmann, H. (Bayerische Biologische Versuchsanstalt, Munich). pp 105-122 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The number of nuclear power plants will increase rapidly in the near future. However much reactor technology advances, a very small part of the radioactive waste products will still be discharged into surface waters for a long time to come. It is thus of prime importance to investigate the behavior of waste products in surface waters. The problem is rendered more difficult as the results of particular investigations cannot usually be generalized; the ecological behavior of radioactive waste products in the receiving waters depends on many factors, varying with locality. Studies may, however, be limited to the long-lived nuclides, as it is only those that are discharged into surface waters, existing there for longer periods. In the Federal Republic of Germany, such investigations are made, for instance, on the upper reaches of the River Danube (below the demonstration nuclear power plant at Gundremmingen). At various dilution points downstream of the plant the activity release is measured and accounted. Measurements of activity in the hydrobiological material of the Danube, i.e. sediments, seston, water plants and fish, are also made. All studies are based on analyses for the individual nuclides; gamma spectrometry (high and low resolution), beta spectrometry (liquid scintillation counting) and radiochemical methods are used. As far as possible, pooled samples are studied. Accumulation factors can be determined that describe the behavior of the radioactive nuclides in the system very well. Large variations caused by biological variety and by the lack of equilibrium conditions were observed. The main activity in the Danube was due to ^{3}H, ^{58}Co and ^{60}Co, ^{89}Sr and ^{90}Sr, ^{131}I, ^{134}Cs and ^{137}Cs, ^{140}Ba, and ^{140}La.

Knowledge of the activity released from the power plant into surface waters, the accumulation in the biomass as well as all the pathways to man allow one to estimate the dose to the population. Internal dose can arise via drinking water, fish consumption, and irrigation of agricultural ground; an external dose can arise from radioactivity absorbed in sediments, mud, etc. The investigations suggest that installation of power plants on the upper reaches of the Danube supplying 10^4 MW(e) would not lead to a dose to the public that conflicts with either national or international radiation protection standards. (auth)

15374 DERIVATION OF SAFE CONTINUOUS RELEASES OF AIRBORNE RADIOACTIVITY FROM THE NATIONAL NUCLEAR RESEARCH CENTRE, PELINDABA. van As, D.; Vleggaar, C. M.; Basson, J. K. (Atomic Energy Board, Pelindaba, South Africa). pp 523-542 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The original permissible release of airborne radioactivity for normal reactor operating conditions from the 70 m high stack at Pelindaba was calculated without meteorological, dispersion or reconcentration data for the site being available at that stage. Since 1968, however, data concerning wind speed, wind direction and the vertical temperature profile were continuously recorded on site and were used to compute the expected incidence of three categories of atmospheric stability in each of eight directional sectors around the site. Experimental determinations of atmospheric dispersion were made for each of these stability categories. The expected incidence of the different stability categories in each direction and the accompanying dispersion data were used to determine the resultant dilution of continuous releases for each sector. The distance at which uniform dispersion is expected to prevail in each sector was calculated and contours of expected equidilution were mapped. This information can be utilized in the planning of the future development of this area. Information regarding the possible levels of exposure of human beings due to the inhalation and ingestion of radioactive materials was gained from studies of the routes through food chains of radioactive nuclides present in nuclear bomb fallout. The food chain, air-pasture-cow-milk-human, proved to be far more restrictive than direct inhalation, and was accepted as being the critical path of exposure due to continuous releases of airborne radioactive effluent. Safe levels of radioactivity in air and milk were calculated and the permissible annual releases of certain critical nuclides, namely ^{131}I, ^{90}Sr and ^{137}Cs, to the atmosphere were derived for the measured parameters of the site. (auth)

15375 RADIOLOGICAL ENVIRONMENTAL IMPACT OF LIGHT WATER REACTORS. Kastner, J. (Atomic Energy Commission, Washington, DC). pp 601-617 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The preparation of an Environmental Impact Statement prior to the licensing of a commercial power reactor requires the assessment of the radiological impact of the proposed facility. A typical detailed evaluation is presented of the impact in the public domain of releases to the environment, including pertinent exposure pathways and probable exposures of individuals and population groups. Examples are given of the atmospheric and hydrospheric models used for the dose estimates. General requirements for off-site radiological monitoring are outlined as well as specific examples of technical specifications such as frequency of sampling and detection sensitivity. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 14748, 15322, 15357, and 15624.

15376 (AD-772062) AVAILABILITY OF RADIOIODINES IN FALLOUT. Final Report, October 5, 1971-June 30, 1973. Norman, J. H. (Gulf General Atomic Co., San Diego, Calif. (USA)). 30 Sep 1973. Contract DAHC20-72-C-0118. 30p. (GULF-GA-A-12682). NTIS $3.00.

A review of the behavior of radioiodine in fallout according to diffusion-limited fission product absorption is presented. It suggests that radioiodines are highly fractionated. The isotopes I-131 through I-135 vary from calculated surface loadings of about 70% for I-131 to about 100% for I-135 for silicate fallout. Coral fallout is expected to have even higher fractions of surface loading. Experiments have been performed to evaluate the vaporization and liquid leaching of iodides from fission recoil loaded samples and vapor loaded substrate. Liquid leaching has been demonstrated as fast for surface oriented iodine. Vapor leaching has been demonstrated as being slow with the exception that exposure to direct environmental conditions greatly accelerates the iodine release. The major effect is thought to be due to sunlight. Ion microprobe studies to observe fission products in a high specific activity fallout were unsuccessful. The instrument did prove capable of some valuable microprobe type studies. (auth)

15377 (CONF-740513-1) RAINFALL INTERCEPTION PROCESS AND MINERAL CYCLING IN A MONTANE RAIN FOREST IN EASTERN PUERTO RICO. Clements, R. G.; Colon, J. A. (Puerto Rico Nuclear Center, San Juan). 1974. Contract AT(40-1)-1833. 27p. Dep. NTIS $4.50.

From mineral cycling in southeastern ecosystems symposium; Augusta, Georgia, USA (1 May 1974).

A comprehensive interception study was carried out in a Montane Rain Forest in Eastern Puerto Rico. Results indicate that the factors of intensity, duration and overall distribution of storms by storm size must be taken into consideration when determining the fate of radioisotopes that reach the forest via rainfall. The relationships rainfall-throughfall and rainfall-stemflow are best described by a linear equation. However, neither is a constant percentage of rainfall but varies with storm size. Although small storms contribute very little to the total annual rainfall, the impact of these storms on the chemical inputs to this tropical ecosystem is major. (auth)

15378 (COO-3254-20) EFFECTS OF ENVIRONMENTAL STRESS ON THE COMMUNITY STRUCTURE AND PRODUCTIVITY OF SALT MARSH EPIPHYTIC COMMUNITIES. Progress Report, September 1, 1973-August 31, 1974. Lee, J. J. (City Coll., New York (USA)). 1974. Contract AT(11-1)-3254. 140p. Dep. NTIS $10.00.

Progress is reported on the following research projects: removal of ^{45}Ca, ^{89}Sr, and ^{90}Sr from coastal marine environments by calcareous foraminifera; autogamy in Allogromia laticollaris; cultivation and physiological ecology of members of salt marsh epiphytic communities; effects of environmental stress on community structure, productivity, energy flow, and mineral cycling in salt marsh epiphytic communities; sensitivity of salt marsh epiphytic algae to gamma radiation, light, and thermal stress; mineral cycling and energy flow; microcosm experiments; nutritional, stress, and physiological experiments on nematodes; field and laboratory studies to characterize changes in bacterial and unicellular algal communities; mixed culture studies on synergistic and antagonistic associations; and field experiments on transplanted communities. (HLW)

15379 (HASL-284 and (App.)) FALLOUT PROGRAM. Quarterly Summary Report, March 1, 1974-June 1, 1974. Hardy, E. P. Jr. (USAEC Health and Safety Lab., New York). 1 Jul 1974. 718p. Dep. NTIS $13.60.

Current data are presented from the HASL fallout monitoring program, the Swedish National Defence Research Institute, the Air Resources Laboratories of NOAA, the Geophysical Fluid Dynamics Laboratory of NOAA and the Radiological and Environmental Research Division of Argonne National Laboratory. The initial section consists of interpretive reports and notes on radioactivity from nuclear tests in air and precipitation in Sweden; ^{90}Sr in diet during 1973; surface deposition in the United States; ^{14}C measurements in the stratosphere during 1971 to 73; and environmental radiation measurements in the vicinity of a boiling water reactor. Subsequent sections include tabulations of radionuclide levels in fallout, surface air, stratospheric air, and ^{89}Sr and ^{90}Sr levels in milk, diet, and tap water. A bibliography of recent publications related to radionuclide studies is also presented. (auth)

15380 (INIS-mf-1137) LONG-LIVED ARTIFICIAL AND NATURAL RADIOISOTOPES IN SEEDS OF CROPS IN MOSCOW ENVIRONS. Pavlotskaya, F. I.; Babicheva, E. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 31p. (In Russian). INIS.

A study was made of the contents and ratios of the chief radioisotopes in seeds of plants grown on plots of the Scientific Research Institute for Agricultural Economy of the central region of nonblack-earth zones during 1961 to 1966 which is distinguished by agrometeorological conditions and intensity of total radioactive fallout. Besides ^{90}Sr and ^{137}Cs, the ^{40}K, one of the chief elements in the ash, ^{230}Th, ^{232}Th, and ^{231}Pa were determined. The average ^{90}Sr and ^{137}Cs in wheat, rye, and barley were close to those in grain grown in the Urals and other parts of the Northern Hemisphere. The contents of these isotopes in grain in different years

reflect the ratios of their uptake from the atmosphere. A correlation was observed between their content in the grain and in the fallout (0.960 for ^{90}Sr and 0.861 for ^{137}Cs). The $^{137}Cs/^{90}Sr$ and $^{137}Cs/^{40}K$ ratios in the grain varied within wide limits, reflecting changes in the fallout rate. (tr-auth)

15381 (NIRS-RSD-38) RADIOACTIVITY SURVEY DATA IN JAPAN. (National Inst. of Radiological Sciences, Chiba (Japan)). Nov 1973. 21p. Dep. NTIS (US Sales Only) $4.25.

On June 27, 1973, The People's Republic of China carried out a nuclear explosion test on a scale equivalent to two megatons TNT. Fallout radioactivity measurements from this test were carried out at nation-wide radioactivity survey stations in Japan. Results of measurements made from June 28 to July 17, 1973, are reported. Measurements of gross β radioactivity in upper air samples from the northern area showed 313 pCi/m^3 and milk samples collected in the Miyagi Prefecture showed 220 pCi/l radioactivity attributed to ^{131}I. The radioactivity survey results were considerably lower than the values in the provisional guide of radioactivity countermeasures established by the Radioactivity Countermeasures Headquarters of Japan. (CH)

15382 (RLO-2225-T20-10) RADIOCARBON IN THE SEA. Progress Report, May 1, 1973–May 1, 1974. Fairhall, A. W. (Washington Univ., Seattle (USA). Dept. of Chemistry). 1974. Contract AT(45-10)-2225. 42p. Dep. NTIS $5.25.

Data are reported from measurements of fallout ^{14}C and natural ^{14}C in samples of seawater collected from various locations throughout the world and at various ocean depths. Results showed that fallout ^{14}C has significantly altered ^{14}C concentrations in the mixed layer but is rapidly transferred by eddy diffusion down to the thermocline. Only small differences were found in the levels of natural ^{14}C in different oceans but fallout ^{14}C levels in ocean waters in the northern hemisphere greatly exceeded those in the southern hemisphere. The use of fallout ^{14}C as a tracer for oceanographic studies is discussed. (35 references) (CH)

15383 (TT-74-50011) NUCLEAR METEOROLOGY. Proceedings of the All-Union Conference on Meteorology, Obninsk, 23–28 June 1969. Makhon'ko, K. P.; Malakhov, S. G. (eds.). 1969. Translated from Russian. (CONF-691076–). 380p. INIS.

Fifty-four papers were presented at the conference and separate abstracts were prepared for 53 papers. One paper was previously abstracted for NSA and appeared as abstract 28: 05761. (LK)

For abstracts of individual papers see: 14839–14844, 15015, 15016, 15275, 15359, 15396–15420, 15427–15431, 15436, 15437, 15464–15467, 15698, 16459, 16810, and 16981–16984.

15384 GLOBAL INPUTS AND BURDENS OF CHEMICAL RESIDUES IN THE BIOSPHERE: THE PROBLEM AND CONTROL MEASURES. Korte, F. (Technische Univ., Munich). pp 3-22 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

After considering the term "environmental quality", some of the more calamitous cases of deterioration in this quality and its consequences are given as examples of what is, at present, possible on a local scale. These chemicals and radioactive materials may enter the environment accidentally, or be put in deliberately, for example as fertilizers, pesticides or waste from some industrial process. If these chemicals are incorporated into the living environment, from the air, food or water, they may concentrate in one organism and then be transferred through the food chain, eventually even reaching man. If at some stage in this transfer, the chemical or its metabolites prove to be harmful, the harm and risk have to be weighed against the benefits gained by its use, and any other alternatives. This requires a scientific knowledge of what the paths and effects of the various foreign compounds are in the environment. Such knowledge, together with quantitative data on the manufacture, pattern of use and disposal of such products would enable risk assessments to be made. (auth)

15385 A BI-DIRECTIONAL MIXING MODEL FOR LEAD ISOTOPE EVOLUTION. Russell, R. D.; Birnie, D. J. (British Columbia Univ., Vancouver (Canada). Dept. of Geophysics and Astronomy). Phys. Earth Planet. Inter.; 8: No. 2, 158-166(Mar 1974).

The characteristics of two-reservoir evolutionary models for radiogenic isotopes are explored. The studies of Russell (1972) are extended to the case of bi-directional transport. Like that earlier study, the paper is based on the hypothesis that the characteristic lead isotope patterns of oceanic basalts and conformable ores betray the existence of at least two major geochemical systems of global extent and great age. The lead-207 deficiency of the oceanic basalt leads is considered to be a fundamental characteristic of the systems. Analytical solutions are obtained for both the case of constant and variable transport rate coefficients. It is shown that both will predict isotopic patterns in accord with those observed, but that the time-variable transport coefficients provide quantitative agreement over a much wider range of parameters. The model of Armstrong (1968) is shown to correspond to a special case of the analytical solutions here derived; study of this case confirms that the Armstrong model cannot provide for the lead-207 discrepancy mentioned above. Otherwise numerical agreement with that model seems acceptable. The most remarkable feature of the models studied is the constancy of the value obtained for the beginning time of evolution of the two systems. Constant rate coefficients give times in the range 3100 ± 300 m.y., and variable rate coefficients give times in the range 3100 ± 200 m.y. This value is compared with the youngest ages of volcanism observed for the moon and the oldest ages for the earth, as discussed by Whetherill (1972). The model also provides information about the distribution of Th/U in an evolving earth. (auth)

15386 WORLDWIDE FALLOUT: ITS EFFECTS ON SCIENCE. Volchok, H. L. (Atomic Energy Commission, New York). pp 227-239 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The global fallout from atmospheric nuclear detonations, though inadvertent, has been the world's largest tracer experiment. In many fields of science, significant advances have been made as a direct result of the addition of fission products to the atmosphere and then onto the earth's surface, into the oceans, and finally into living things. Atmospheric circulation, stratosphere-troposphere interchange, and interhemispheric mixing are being studied using the fallout debris. In oceanography ^{90}Sr and ^{137}Cs from fallout are very useful for revealing features of both surface and deeper circulation, and mixing rates, while other nuclides are used in sedimentation studies. In biological and medical research, alkaline earth metabolism in bone and the distribution of potassium in the human body are two examples of knowledge gained through fallout. In addition, numerous instrumentation and engineering developments have emerged in response to requirements for improved precision and accuracy in fallout investigations. (auth)

15387 RADIOACTIVE FALLOUT IN THE MEDITERRANEAN REGION: RESEARCHES, RESULTS, AND PERSPECTIVES. Cigna, A. A. (CNEN, Casaccia, Italy); Polvani, C. pp 240-258 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The most detailed studies on exposure of man from fallout radioisotopes are being performed in the cold temperate regions of the northern hemisphere. The prevailing damp climate and agronomic characteristics are not applicable to the warm (and dry) temperate regions of the countries of the Mediterranean area. Consequently, a study of the exposure from fallout in Italy, even if not complete, can be useful in assessing the risks to the population living in such environmental conditions and in determining whether some significant differences in the exposure exist between these populations and those of the northern hemisphere. The preeminent interest lies in exposure from ingestion: in this case, the agronomic characteristics of the region considered and the food habits of the population living in that region are of the utmost importance. With reference to Italy, the intake of ^{131}I contained in milk, and of ^{137}Cs, ^{89}Sr, and ^{90}Sr supplied by the total diet are reviewed. The inhalation of radioactive particles is also examined. Special attention is given to large particles in air and in the lungs. Due to either the low level, or the absence of radioactive contamination from fallout, the actual trend of the research concerns the study of the distribution patterns and the behavior of stable elements in the biosphere. The concentration phenomena play an important role in the establishment of ecocycles of the radionuclides (fission and activation products) produced by nuclear power and research plants, and the experience gained with fallout studies proves to be very useful for the solution of problems deriving from nonradioactive pollutants also. (auth)

15388 AIRBORNE AND DEPOSITED RADIOACTIVE FALLOUT OVER SOUTHERN AFRICA AND THE RESULTANT BIOLOGICAL UPTAKE OF ^{90}Sr, ^{137}Cs, AND ^{131}I. Basson, J. K.; van As, D.; Vleggaar, C. M. (Atomic Energy Board, Pretoria). pp 259-278 of Proceedings of the Regional Conference on Radiation Protection. Vol 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Determinations of deposited fallout radioactivity have been performed in Southern Africa routinely since 1956. Originally only gross beta-activity was measured at a single location. As from 1958 results of the HASL monitoring program are available for radioactive strontium in fallout at two stations, viz., Pretoria and Durban. During 1965, a more comprehensive program was established for the monitoring of air and rain, with analyses for individual gamma-emitting nuclides as well as for ^{90}Sr. This program was progressively expanded to include four stations, viz., Pretoria, Cape Town, Lourenco Marques (Mozambique), and Windhoek (South West Africa). The concentration of ^{90}Sr and ^{137}Cs in milk and maize-flour, the two most important contributors to the dietary uptake of ^{90}Sr by the South African population, are determined routinely on a countrywide basis. Samples of human rib bone are regularly obtained and ^{90}Sr analyses are performed on samples from various race and age groups. During periods of fresh fallout originating from nuclear bomb explosions in the Southern Pacific Ocean, the monitoring program was intensified to obtain information on atmospheric transport, to carry out age analyses, and to determine transfer characteristics of airborne activity to the food chain. Results of interest to health physics have been obtained, e.g., the relationship between airborne and deposited fallout and the transfer of airborne ^{131}I to milk. (auth)

Atmosphere

Refer also to abstracts 14839, 14840, 15015, 15016, 15061, 15375, 15465, 15562, and 17776.

15389 (COO-1407-52) NUMERICAL MODELS FOR PRECIPITATION SCAVENGING. Lee, Y. (Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric and Oceanic Science). Apr 1974. Contract AT(11-1)-1407. 96p. Dep. NTIS $8.00.

Thesis.

Two models are developed. The first is designed for precipitation scavenging in stratiform clouds. This model incorporates heuristic approximations of diffusive attachment, impact collection and accretion, and includes consideration of particle and cloud droplet size spectra. An overriding, independently generated steady rain removes contaminated cloud droplets and contaminant particles. The conservation of contaminant mass is expressed by a set of three ordinary differential equations for which analytic solutions are derived. Rainout ratios and efficiencies are computed, and the results compare favorably with available field measurements. It is shown 1) that no single attachment rate constant or removal rate constant can adequately express the removal by rain of airborne contaminant, 2) that the contaminant concentration in the cloud air decreases exponentially with time when the processes of diffusive attachment and rainfall removal are considered, and 3) that the fraction of the air concentration of contaminant that is attached to the cloud droplets is affected by processes of particle attachment and rainfall removal, hence its temporal change shows an initial rapid rise to a maximum which is followed by a variable decrease that depends upon the rainfall rate and the cloud water content. The second model addresses the problem of air cleansing by a convective rain-generating system. In this model, raindrop growth and motion in spatial contaminant concentration gradients are of major concern. Numerical solutions for raindrops growing by coalescence with cloud droplets and moving in a cylindrically symmetric motion field within a steady-state cloud are provided. The drop breakup process is formally accounted for, and, in the sub-cloud region, evaporation is considered. The cloud water and contaminant concentration are assumed to vary both with height and horizontal distance from the up-draft core. A bell-shaped updraft profile is assumed. The contaminant concentrations of individual raindrops are computed. Because the updraft core is identified with the maxima of liquid water content and contaminant concentrations, (a) the coalescence growth process is most rapid in the upward passage of droplets through the cloud rather than the downward passage; (b) high concentration of contaminant tends to be associated with the larger drops formed near the core and lower concentration tends to be found in the smaller drops formed farther away from the core, and these associations produce a positive correlation between rainfall rate and contaminant concentration. Sub-cloud evaporation, on the other hand, tends to produce a negative correlation between these two parameters because it affects the small drops much more strongly than the large ones. Drops of different sizes can therefore have the same concentration, and under the assumed conditions a particular drop-size is identified with the minimum concentration. (auth)

15390 (NOAA-TM-ERL-ARL-42) PROGRAM FOR EVALUATING ATMOSPHERIC DISPERSION FROM A NUCLEAR STATION. Sagendorf, J. F. (National Oceanic and Atmospheric Administration, Idaho Falls, Idaho (USA). Air Resources Lab.). May 1974. 16p.

A computer code (SEP for Site Evaluation Program) is described. The program uses a joint frequency distribution of winds and stability classes to evaluate the atmospheric dispersion potential near a nuclear power station. The code includes models for short-term and long-term effluent releases. A description of the input parameters is included. (auth)

15391 (NP-20048) MEASUREMENTS OF THE RADIOACTIVITY OF THE AIR IN 1973 [VIENNA]. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). [nd]. 12p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The results of daily three-hour monitoring of the radioactivity of the ground-level atmosphere in Austria are tabulated by months. (JSR)

15392 (NP-20049) THREE-HOUR MEASUREMENTS OF THE RADIOACTIVITY OF GROUND-LEVEL ATMOSPHERE IN 1973 [VIENNA]. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). [nd]. 13p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The results of daily monitoring of the radioactivity of the ground-level atmosphere are tabulated by months. (JSR)

15393 (NP-20050) MEASUREMENTS OF THE RADIOACTIVITY OF THE AIR IN 1973 [KLAGENFURT]. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). [nd]. 13p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

Results of daily monitoring of the radioactivity of the ground-level atmosphere are tabulated by months. (JSR)

15394 (NP-20051) MEASUREMENTS OF THE RADIOACTIVITY OF THE AIR IN 1973 [SALZBURG]. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). [nd]. 13p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The results of daily monitoring of the radioactivity of the ground-level atmosphere are tabulated by months. (JSR)

15395 (NP-20052) MEASUREMENTS OF THE RADIOACTIVITY OF THE AIR IN 1973 [BREGENZ]. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). [nd]. 7p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The results of daily monitoring of the radioactivity of the ground-level atmosphere are tabulated by months. (JSR)

15396 (TT-74-50011, pp 1-16) VERTICAL DISTRIBUTION OF RADIOACTIVE AEROSOLS IN THE TROPOSPHERE OVER THE EUROPEAN USSR IN 1964-1967. Nazarov, L. E.; Voloktina, L. A.; Gaziev, Ya. I.; Kuzenkov, A. F.; Malakhov, S. G.; Vasil'ev, A. S. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Data are given on the vertical distribution of the concentration of decay products of radon and aerosol products of nuclear blasts in the troposphere over the USSR in 1964-1967. Aerosynoptic analysis of cases of considerable growth and decrease in the concentration of fission products in the ground air layer in the vicinity of Moscow established that the drift of stratospheric aerosols into the upper troposphere takes place at the tropopause discontinuity or funnel at the cyclonic periphery of the jet. At ground level the radioactive spot appears most frequently beneath the anticyclonic periphery of the jet. Examination of the simplest theoretical models of the vertical concentration distribution of fission products and short-lived decay products of radon in the troposphere yields the coefficient of vertical turbulent diffusion k_z and speed of vertical ordered motion ω, whose values are given. (auth)

15397 (TT-74-50011, pp 17-28) DISTRIBUTION OF FISSION PRODUCTS OVER OCEANS IN THE TROPICAL ZONE AND THEIR RELATION TO ATMOSPHERIC PROCESSES. Dmitrieva, G. V.; Krasnopevtsev, Yu. V.; Malakhov, S. G. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Data (for the period 1967-1968) are examined regarding the latitudinal distribution of the concentration of fission products over oceans in different regions of the tropical zone. The data show that the air at sea level in the tropical zone over the Indian Ocean and the West Pacific in the considered period is very inhomogeneous as regards the content of radioactive products. This inhomogeneity was caused by the influx in the tropical zone of air with higher radioactivity from subtropical or moderate latitudes

(winter hemisphere) after the passage in these latitudes of quasi-meridional cold fronts. These incursions possibly contribute sometimes also to the formation of separate zones of convergence lines in the equatorial region. Under certain synoptic conditions, the air entering the equatorial region from extratropical latitudes at times crossed the equator and could be included in the circulation of the other hemisphere. The assumption is made that, after their transformation into deep wide cyclones, Pacific typhoons can contribute to the transport of air from the southern to the northern hemisphere. (auth)

15398 (TT-74-50011, pp 37-39) RADIOACTIVE ISOTOPES OF EUROPIUM PRODUCED BY NUCLEAR BLASTS. Iokhel'son, S. V.; Nazarov, I. M.; Rovinskii, F. Ya.; Chirkov, V. P.; Yushkan, E. I. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Nuclear blasts lead to the appearance of different radioisotopes of europium: europium-155 ($T_{\frac{1}{2}}$ = 1.7 years), europium-156 ($T_{\frac{1}{2}}$ = 15.4 days), which are fission fragments, and europium-152 ($T_{\frac{1}{2}}$ = 12 years), europium-154 ($T_{\frac{1}{2}}$ = 16 years)-products of activation reactions. According to data in the literature, these isotopes were detected in the epicentral region of nuclear tests conducted in Nevada (USA). On the other hand, they have not been detected in the composition of radioactive global contamination of the earth's surface. To determine the contribution of long-lived europium radioisotopes to the global contamination of a locality, a sample of moss gathered in the Caucasus (in the vicinity of Lake Rits) was analyzed by the methods of radiochemistry and gamma spectrometry. In the sample, in addition to other fragmentation products, the presence of europium-155 was detected and identified reliably for the first time. It was also established reliably that no europium-152 and 154 is present. The density of the global contamination of dry land by europium-155 and its contribution to the gamma dose were hence evaluated. (auth)

15399 (TT-74-50011, pp 57-60) RATE OF ATMOSPHERIC FALLOUT OF CESIUM-137 AND STRONTIUM-90 AEROSOLS. Zykova, A. S.; Telushkina, E. L.; Rublevskii, V. P.; Efremova, G. P.; Kuznetsova, G. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Data are given on the fallout density of ^{137}Cs and ^{90}Sr aerosols in Moscow for the period 1962 to 1968 and on the concentration of these isotopes in the ground layer of atmospheric air. It is shown that the ratio of ^{137}Cs and ^{90}Sr aerosols in radioactive precipitation in these years was always larger than the analogous ratio between these isotopes in air. This leads to the supposition that the fallout rate of aerosols carrying ^{137}Cs is somewhat larger than the fallout rate of aerosols carrying ^{90}Sr. An assessment of the fallout rate of these aerosols established that, on the average, for the period 1962 to 1968 the fallout rate of ^{137}Cs aerosols was 1.7 ± 0.4 cm/sec, and of ^{90}Sr aerosols 1.5 ± 0.4 cm/sec, i.e., the fallout rate of ^{137}Cs aerosols is larger by 14% than the fallout rate of ^{90}Sr aerosols. (auth)

15400 (TT-74-50011, pp 88-94) FORMATION OF RADIOACTIVE PARTICLES DURING NUCLEAR BURSTS IN THE TROPOSPHERE. Izrael, Yu. A.; Ter-Saakov, A. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A theoretical model of aerosol radioactivation in the fireball of a nuclear burst is examined. Formulas are derived for the distribution of the radioactivity of isotopes on the aerosol particles as a function of particle radius. Three mechanisms of particle radioactivation are treated. In the first case, condensation of radioactive isotope vapors occurs at temperatures higher than the vaporization temperature of the soil particles (~2,300°C), i.e., under conditions far removed from thermodynamic equilibrium. Such is the case for isotopes of zirconium, lanthanum, yttrium, and other refractory elements. In the second case the condensation of radioisotopes occurs on the surface of fused soil particles, i.e., under conditions of thermodynamic equilibrium (in the temperature range 2,300 to 1,400°C). In the third case aerosol activation is determined by radioisotope sorption on the surface of solid particles. Such is the case for isotopes that have gaseous precursors with half-decay periods from tens of seconds to several minutes (^{89}Sr, ^{90}Sr, ^{137}Cs, ^{140}Ba). The influence of the precipitation of large particles from a cloud at the moment of radioactivation is taken into account. (auth)

15401 (TT-74-50011, pp 101-103) ATMOSPHERIC FORMATION OF SECONDARY AEROSOLS DURING VENTILATED UNDERGROUND NUCLEAR TESTS. Petrov, V. N.; Ter-Saakov, A. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

In underground nuclear tests, some radioactive products may be discharged into the atmosphere through excess pressure or ventilation due to the destruction of rocks in the test area and the formation of cracks near ground level. The direct outflow into the atmosphere of nongaseous radioactive products is hardly probable, due to their sorption in the subsoil rock layer. It is therefore natural to assume that, in the main, chemically inert gases (such as the isotopes of krypton and xenon) are discharged into the atmosphere. The appearance of nonvolatile radioisotopes in the atmosphere can be associated with the decay of radioactive gases, which are the precursors of such isotopes in the corresponding chains of radioactive transformations. Nongaseous radioisotopes formed in the atmosphere are deposited on atmospheric dust particles and form so-called "secondary" aerosols. A model of the atmospheric formation of the decay products of gaseous radioisotopes during underground nuclear tests is examined. (auth)

15402 (TT-74-50011, pp 104-110) SIZE DISTRIBUTION OF HIGH-ACTIVITY PARTICLES IN THE TROPOSPHERE IN SEPTEMBER-DECEMBER 1967. Gaziev, Ya. I.; Malakhov, S. G.; Nazarov, L. E. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

High-activity particles of artificial radioactive aerosols were observed in the troposphere in September-December 1967. The "age" of the aerosols at the beginning of the observation period was ~2.5 months. Radioactive particles of diameter $d \geq 0.9\ \mu$ were investigated. According to the results obtained in the ground layer of the atmosphere and the upper troposphere, the integral and differential size distribution of these particles was exponential for $d \geq 0.9\ \mu$. On the average for the troposphere the exponent was equal to (1.4 ± 0.2) d micron^{-1}. For radioactive particles of diameter between 2 and 6 μ, the fractionation coefficients of the isotopes ^{144}Ce, ^{141}Ce and ^{103}Ru were determined with respect to ^{95}Zr. The values of these coefficients were roughly the same as those given earlier in the literature for micron particles of atmospheric nuclear blasts. The time of residence in the stratosphere of particles of diameter between 2.5 and 6 μ was roughly 4.5 months. The scavenging rate of radioactive particles of micron size (d = 1-6 μ) in the lower troposphere was close to 2 km/day. (auth)

15403 (TT-74-50011, pp 111-117) STATE OF STRONTIUM-90, CESIUM-137, AND CERIUM-144 IN RADIOACTIVE FALLOUT. Pavlotskaya, F. I.; Surotkevichiene, R.; Levina, G. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Investigations into the state and chemical form of existence of ^{90}Sr, ^{137}Cs and ^{144}Ce in global fallout during 1958-1968 are described. Substantial differences are shown between the soluble and insoluble fractions in the distributions of the different radionuclides. Independently of the geographical location of the observation stations, the decreasing soluble fraction in the indicated period is preserved in the sequence $^{90}Sr > ^{137}Cs > ^{144}Ce$, the values being on the average 78, 62 and 16%, respectively. The radionuclides in the insoluble fraction possess different mobilities. When treating the insoluble remainder by 1 N CH_3COONH_4 and 1N HCl, more than 90% of the ^{90}Sr and up to 65-70% of the ^{137}Cs and ^{144}Ce pass into the solution. The latter indicates that most of the radionuclides in the insoluble fraction are in exchange and mobile states, and not in the form of slightly soluble compounds (such as CeO_2). In a soluble state, the radionuclides are present in cationic, anionic and neutral forms. The ratios between the latter are different in the various radionuclides. The distribution between these three forms is 90, 6, and 4% for ^{90}Sr, 72, 16, and 12% for ^{137}Cs, 55, 18, and 27% for ^{144}Ce. A certain trend is observed toward an increase in the relative fraction of ^{90}Sr and ^{137}Cs in anionic form and a decrease in the fraction in neutral form during the winter compared with the summer period. The different mobility of the radionuclides in insoluble fractions and their existence in cationic, anionic and neutral forms in a soluble state indicate the formation of different compounds and the variety of forms of their arrival at the earth's surface. (auth)

15404 (TT-74-50011, pp 118-132) THEORETICAL NOTIONS OF RADIOACTIVITY ACQUISITION BY RAINDROPS. Avramenko, A. S.; Makhon'ko, K. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

An approximate model is given of the acquisition of radioactivity by raindrops during their formation and precipitation from a cloud. The processes taking place in a cloud with ordered ascending currents, leading to the size distribution of the specific radioactivity of raindrops observed on the earth, are examined. Comparison of theoretical calculations of the concentration of the products of nuclear bursts in raindrops of different sizes with experimental data enabled us to determine the value of the coefficient of radioactive

aerosol–particle washout by cloud-borne droplets ($\sigma_0 \sim 10^{-3}$ sec^{-1}) and to establish the existence of an inverse relationship between the concentration of nuclear burst products in cloud-borne droplets and their radius. This relationship is near-inverse for raindrops. It is shown that the obtained size distribution of the specific radioactivity of raindrops can lead to an increase in the specific radioactivity of rainwater at the end of brief showers due to the decrease in raindrop size. (auth)

15405 (TT-74-50011, pp 133-136) DISTRIBUTION OF RAINDROPS WITH RESPECT TO SPECIFIC RADIOACTIVITY. Syro, B. L; Vebrene, B. K. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The distribution of raindrops was investigated with respect to their specific radioactivity. The distribution curves of droplets are similar for a uniform distribution of the isotope and when it is introduced at some point in the cloud. The position of the maximum on the curve depends on the isotope quantity. The variation in the specific radioactivity of rain during its fall was also investigated. The first specific radioactivity maximum appears several minutes after the isotope is introduced in the cloud. The second, not so sharp maximum appears after 10–15 min. The very rapid (3–4 min) appearance of activated droplets at the earth's surface is associated with the accelerating effect of descending air currents. (auth)

15406 (TT-74-50011, pp 137-145) APPLICATION OF THE STOCHASTIC APPROACH TO THE PROBLEM OF THE RADIOACTIVITY OF RAINDROPS AND CLOUD-BORNE DROPS. Avramenko, A. S. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

An attempt is made to apply the stochastic approach to the problem of the radioactivity of raindrops and cloud-borne drops. A general system of equations is written with which to calculate the distribution function of the cloud-borne drops with respect to activity for the radioactive series of natural decay products in elemental state. A steady solution is given for the case when the concentrations of the preceding elements of the radioactive series can be neglected. The obtained distribution is used to derive a relationship between the number of nonradioactive raindrops and their size. The theoretical relationships and published experimental data are in satisfactory agreement. (auth)

15407 (TT-74-50011, pp 154-165) ATMOSPHERIC WASHOUT OF RADIOACTIVE CONTAMINANT IN THE MOUNTAINS OF CENTRAL CAUCASUS. Avramenko, A. S.; Makhon'ko, K. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The coefficient σ of radioactive dust washout from the subcloud layer of the atmosphere was determined by measuring the contaminant concentration in precipitation at two different altitudes in 1968–1969 in mountains. The mean value of σ for the products of nuclear bursts in steady rain was $3 \cdot 10^{-5}$ sec^{-1}; for showers σ is roughly twice as large, and for snows five times as large. Measurements during steady rain for upslope and downslope winds enabled the mean speed of the ascending air currents to be estimated as ~0.6 m/sec. With increase in precipitation intensity I the value of σ decreased rapidly at first, passed through a minimum when I ~ 1 mm/hr, and then increased. It is shown that vertical air currents affect the obtained relationship. When measuring σ for short-lived decay products of radon, samples were taken simultaneously at two altitudes, a radiotelephone being used to ensure simultaneity. Due to the brief sampling time of rapidly decaying samples, the influence of fluctuations in the concentration of natural radioactivity in precipitation (C) and in air (q) and fluctuations in precipitation intensity was so large that it was not possible to determine σ for rains; for snow $\sigma \sim 9 \cdot 10^{-5}$ sec^{-1} with a 95% error. Similarly, we were unable to detect from the results of 313 observations a time-dependence of the specific radioactivity of precipitation (C) against the background of the large fluctuations in the measured quantity. In spite of the large scatter of the individual values of C, it was possible to observe a decrease in C with increasing I. A study of the polar diagrams of q and C showed that the ground concentration of short-lived decay products of radon is affected by exhalation mainly within a radius of several kilometers, while the concentration in precipitation is affected within a radius of tens of kilometers. (auth)

15408 (TT-74-50011, pp 173-181) SOME FEATURES OF ATMOSPHERIC CLEANSING BY GROUND CONDENSATION. Syro, B. L; Dargene, N. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Simultaneous measurements were conducted of the radioactivity of air and dew samples formed on the upper and lower surfaces of a polyethylene film spread on closely cut grass. The dew samples were collected in two ways: (1) several identical films were spread simultaneously on the grass surface, the sample from the first film being taken immediately after the formation of the dew with subsequent sampling at hourly intervals throughout the night; (2) a single polyethylene film on the selected area was changed hourly and the radioactivity of the dew formed on it determined. The dew samples collected by the two methods were called "old" and "new" dew, respectively. The short-lived α-radioactivity of the dew due to the decay of $_{84}Po^{218}$, $_{82}Pb^{214}$ and $_{83}Bi^{214}$ was determined. For old dew they lie in the range $(0.1-24.5) \cdot 10^{-11}$ Cu/ml, and for the new dew in the range $(0.1-26) \cdot 10^{-11}$ Cu/ml. The parameter of radioactivity removal from the air during the fall of dew is $(0.02-1) \cdot 10^{-4}$ sec^{-1} for old dew and $(0.3-1) \cdot 10^{-4}$ sec^{-1} for new dew. A parabolic relationship was obtained between the specific radioactivity of new dew and the specific radioactivity of the air, which points to the growth in washout intensity with increasing air radioactivity. The specific radioactivity and the coefficient of nonradioactive removal of radioactive substances by old dew were studied as a function of the amount of fallen dew. It was concluded that atmospheric cleansing occurs mainly: (1) through direct condensation of water vapor on radioactive aerosols; (2) under the influence of electric interactions between the aerosol particles and the dewdrops. (auth)

15409 (TT-74-50011, pp 182-186) RELATION BETWEEN ATMOSPHERIC PRECIPITATION WASHOUT OF RADIOACTIVITY AND NONACTIVE IONS. Piskunov, L. L.; Tarasov, S. I. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A correlation in the form of a power relationship is assumed between the atmospheric washout of radioactive and nonactive contaminants. As the latter chlorides and sulfates were selected, differing from the others in that their background ratio in atmospheric precipitation for the continental part of European USSR is stable. For a tropospheric background radioactivity, the constancy of the relation in atmospheric precipitation of the radioactivity with respect to the chlorides and the sulfates follows from their identical washout laws. It is possible to derive an approximate evaluation of the radioactive state of the atmosphere. It is assumed that the absence of a correlation between dust washed out from the atmosphere, radioactive components, and the background concentration of nonactive ions can serve as an indicator of anomalous phenomena. (auth)

15410 (TT-74-50011, pp 187-193) ACCOUNTING FOR SOME NONSTEADY PROCESSES IN RECORDING NATURAL AIR RADIOACTIVITY. Bakulin, V. N.; Matulyavichyus, V. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The accumulation of radon disintegration products is studied theoretically for recorders with fixed and mobile filters, for constant and linearly increasing concentration of these products in air, taking into account the relation between their concentrations. It is demonstrated that neglecting the equilibrium in the radon series can lead to an error several times greater when determining the concentration of radon and its disintegration products in air from measurements of the activity of recorder filters. A formula is proposed for determining constant concentrations of Rn and its disintegration products in air by various suction methods in relation to the degree of equilibrium in the radon series. The optimum filtration time for a recorder with a mobile filter is shown to be at most 1.5–2 hr; longer times do not practically increase the sensitivity of the setup, but increase the recorder's time constant and render more difficult determination of the actual time variation in the concentration of radioactive substances. A method is suggested for determining the relationship between radon disintegration products measured by two counters, one positioned in the path of the recorder film. Very reliable data can thus be obtained for an α-recorder, at minimum spacing between the two counters. (auth)

15411 (TT-74-50011, pp 201-207) LONG-LIVED ALPHA-RADIOACTIVITY IN FALLOUT AT VILNIUS AND AT VARIOUS ATLANTIC LATITUDES. Syro, B. L; Shpirkauskaite, N. K.; Gasyunas, V. N.; Kuptsov, V. M. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The isotope composition of long-lived alpha-radiation in atmospheric precipitation at Vilnius and at different latitudes over the Atlantic is investigated. Relevant data were obtained for each 10° latitudinal strip between 60°N and 70°S over the Atlantic from 16 October 1966 till 1 March 1967 and from 21 October 1967 till 26 January 1968. The fallout density of long-lived alpha-radio-

activity is described by the geographical distribution with maxima at 50–40° and 20–30°N and S and with minima at 40–30°N and S. The ^{238}U, ^{232}Th and ^{239}Pu contents in atmospheric precipitation were measured using an alpha-spectrometer with ion chamber, and their ratios were calculated. For Vilnius, the ^{238}U values are 0.41 to $7.33 \cdot 10^{-6}$ g/g, the ^{232}Th values are 0.014 to $7.27 \cdot 10^{-6}$ g/g, and the ^{239}Pu values are 0.04 to $3.10 \cdot 10^{-11}$ g/g; over the Atlantic the values are 0.18 to $9.5 \cdot 10^{-6}$, 0 to $(0.52-1.8) \cdot 10^{-6}$ and 0.06 to $7.37 \cdot 10^{-10}$ g per gram of ash residue, respectively. (auth)

15412 (TT-74-50011, pp 220-223) RADIUM-226 IN ATMOSPHERIC PRECIPITATION, AND THE POSSIBILITIES FOR LEAD-210, BISMUTH-210, AND POLONIUM-210 TO PENETRATE THE ATMOSPHERE FROM THE EARTH'S SURFACE. Vilenskii, V. D. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The intensity of atmospheric ^{226}Ra and ^{210}Pb fallout in the Moscow area in 1967–1969 was determined. It varied between 0.08 and 1.8 $\mu Ci/km^2 \cdot day$ for ^{226}Ra (mean-annual value 0.18 $mCi/km^2 \cdot year$) and between 1 and 18.6 $\mu Ci/km^2 \cdot day$ for ^{210}Pb (mean-annual value 2.1 $mCi/km^2 \cdot year$). The ratio of ^{226}Ra to ^{210}Pb concentrations in atmospheric precipitation varied between 0.024 and 0.222, the mean-annual value being 0.086. Assuming ^{226}Ra penetrates the atmosphere from the earth's surface along with dust, the proportions of ^{210}Pb, ^{210}Bi and ^{210}Po penetrating the atmosphere with the dust have been evaluated along with the overall concentration of these radioisotopes in atmospheric precipitation. The natural radioactivity of atmospheric dust is shown to possibly influence the proportion of isotopes used for evaluating the rate of atmospheric scavenging. (auth)

15413 (TT-74-50011, pp 224-231) POLONIUM-210 IN THE ATMOSPHERE AND ITS RATIO TO LEAD-210. Shalaveyus, S. S.; Styro, B. I. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The ^{210}Pb and ^{210}Po concentrations in atmospheric air and precipitation were measured in the environs of Vilnius. ^{210}Po was determined from its α-activity after being separated from the other α-emitting elements by spontaneous precipitation on copper. The purity of ^{210}Po separation was checked with the aid of A-2 nuclear emulsions. EDE-10P anionite was used to separate ^{210}Pb. The chemical yield was determined from the carrier, and the purity from the ^{210}Bi accumulation curve. In 1966–1968, the ^{210}Po concentration in atmospheric air was 3.5 to $71.4 \cdot 10^{-16}$ curie/m^3. The $^{210}Po/^{210}Pb$ ratio in that period fluctuated between 0.07 and 0.22; the higher values indicate that air in which ^{210}Pb and ^{210}Po has accumulated for a long time was sometimes released into the ground layer. In 1967–1968, the ^{210}Po concentration in precipitation varied between 0.2 and $1.9 \cdot 10^{-12}$ Ci/liter, and the $^{210}Po/^{210}Pb$ ratio varied between 0.1 and 0.37. An inverse correlation was found between the ^{210}Po concentration in precipitation and that in the atmosphere. The average residence time of ^{210}Po and ^{210}Pb in the atmosphere was about 32 days. (auth)

15414 (TT-74-50011, pp 232-238) TIME FLUCTUATIONS OF LEAD-210 CONCENTRATION IN THE GROUND LAYER OF THE ATMOSPHERE. Malakhov, S. G.; Trufakin, V. A.; Shulepko, Z. S. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Data on the mean-annual ^{210}Pb concentration in the ground layer of the atmosphere are given for various points in the world. This concentration varies between 10^{-14} and 10^{-15} Ci/m^3 deep inland, 1 and $2 \cdot 10^{-15}$ Ci/m^3 over the oceans in the northern hemisphere, and equals 10^{-16} Ci/m^3 in the polar areas of both hemispheres. Measurements in the Antarctic have revealed seasonal variations with a maximum in summer. Short-term (2–3 day) fluctuations are studied and assessed from measurements around Kirov. It is shown that cold-air advection from the Arctic usually reduces considerably the ^{210}Pb concentration. (auth)

15415 (TT-74-50011, pp 245-254) FILTERING AEROSOLS WITH NATURAL ATMOSPHERIC RADIOACTIVITY THROUGH FIBROUS MATERIALS. Ogorodnikov, B. I.; Skitovich, V. I.; Sitalo, E. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

It has been proved experimentally that, at a filtration rate of about 150 cm/sec, FPP-15 and FPA-15 materials have approximately the same efficiency, but the former is more effective at a rate of about 1 to 10 cm/sec owing to the presence of electrostatic charges on its fibers. FP material is suitable for use in the upper atmosphere, as its efficiency in trapping aerosols of all sizes increases. For instance, the efficiency of FPA-15 material in trapping aerosols of about 0.035 μ particle radius at filtration rates of 1 to 65 cm/sec is approximately 10 to 12 times as high at 27 km as at ground level. A study of radioactivity distribution over the layers of the filtering material has shown that particles of that size account for 40 to 60% of the radioactivity of radon daughter products in the ground layer of the atmosphere. EP filtering was studied experimentally with air containing coarse aerosols (1 to 15 μ) and with practically pure air containing a large amount of free atomic Ra daughter products. The "free" products filter with very high efficiency with a high diffusion coefficient, even at rates of 300 cm/sec. (auth)

15416 (TT-74-50011, pp 340-346) FALLOUT AND ACCUMULATION OF RADIOACTIVE DECAY PRODUCTS IN 1966–1968 IN THE VICINITY OF LENINGRAD. Vasil'eva, N. V.; Gedeonov, L. I.; Gritchenko, Z. G.; Zhilkina, M. I.; Flegontov, V. M. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Results are presented of observations of the isotope composition of global radioactive fallout in 1966-1968 in the Leningrad region, the fallout density of radioactive fission products, and the amount of radioactive products deposited on the ground surface at the observation point. ^{141}Ce, ^{103}Ru, and ^{95}Zr were recorded in 1966-1968 in the ground layer of the atmosphere and in atmospheric precipitation. Longer-lived radionuclides such as ^{144}Ce and ^{106}Ru, mostly penetrating from the stratospheric source of radioactive contamination, in 1968 contributed much to the overall proportion of total beta activity. The recording of these radionuclides in radioactive fallout samples in 1967 was at the sensitivity limit of the measuring instruments. The fallout density of ^{90}Sr was 1.6 mCi/km^2 in 1966, 0.8 mCi/km^2 in 1967, and 1.0 mCi/km^2 in 1968; that of ^{137}Cs was 1.3, 1.7 and 1.9 mCi/km^2, respectively. Altogether 50.3 mCi/km^2 ^{90}Sr and 96.9 mCi/km^2 ^{137}Cs fell to the ground in 1954-1968 in the vicinity of Leningrad (the figures refer to the moment of fallout). Based on an analysis of the activity ratio of short-lived radionuclides (^{141}Ce, ^{95}Zr) to long-lived ones (^{90}Sr, ^{106}Ru, ^{137}Cs, ^{144}Ce), the global radioactive fallout in the Leningrad district in 1966-1968 is shown to be due almost entirely to 1966-1967 nuclear explosions, while ^{90}Sr and ^{137}Cs from earlier nuclear tests were present in insignificant amounts only. At the end of 1968, the accumulated activity of the total beta-radioactive fission products was ~ 0.35 Ci/km^2, that of $^{144}Ce + ^{144}Pr$ was ~ 13 $mcurie/km^2$, ^{106}Ru ~ 6 mCi/km^2, $^{95}Zr + ^{95}Nb$ ~ 0.55 mCi/km^2, and that of ^{141}Ce was below 0.1 mCi/km^2. Owing to the low rate of ^{90}Sr and ^{137}Cs fallout, the accumulated activity of these radionuclides remained at the 1965 level of 42.3 and 82 mCi/km^2, respectively. (auth)

15417 (TT-74-50011, pp 347-352) PENETRATION OF RADIOACTIVE FISSION PRODUCTS FROM 1964–1967 NUCLEAR TESTS INTO THE GROUND LAYER OF THE ATMOSPHERE IN THE LENINGRAD AREA. Gedeonov, L. I.; Gritchenko, Z. G.; Flegontov, V. M. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Radioactive fission products formed during tests of nuclear weapons in countries that did not adhere to the Moscow agreement on the prohibition of nuclear tests in the three media were recorded in 1964–1968 in the ground layer of the atmosphere in the Leningrad area. The following radioactive isotopes were determined with the aid of a scintillation and a Ge(Li) drift gamma spectrometer in radioactive aerosols filtered out of the ground layer of atmospheric air: ^{140}Ba, ^{140}La, ^{141}Ce, ^{103}Ru, ^{95}Zr, ^{95}Nb, ^{144}Ce, ^{106}Ru, and ^{137}Cs. The forming of these radioactive fission products was dated from the activity ratios of the following pairs of radionuclides: $^{140}Be/^{141}Ce$, $^{141}Ce/^{95}Zr$, $^{141}Ce/^{144}Ce$, $^{95}Zr/^{144}Ce$, and $^{144}Ce/^{137}Cs$. These radionuclides turned out to have been released into the atmosphere during the explosions of 14 October 1964, 14 May 1965, 9 May, 27 October and 28 December 1966, 17 June and 24 December 1967. Atmospheric nuclear tests of increasing power and the depletion of the stratospheric reserve of radioactive fission products from the 1961-1962 test series produced a stable balance in the stratosphere between the long-lived radionuclides from nuclear tests conducted in 1964-1967. The proportion of long-lived fission products from these nuclear explosions therefore began to predominate in 1966 in global radioactive fallout. (auth)

15418 (TT-74-50011, pp 358-360) VERTICAL DISTRIBUTION OF THE CONCENTRATION OF RADON DECAY PRODUCTS IN THE 0–300-M LAYER. Kirichenko, L. V.; Malakhov, S. G. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Data on the vertical distribution of the concentration of radon decay products in the 0–300-m layer of the atmosphere are provided. The measurements were carried out in August 1961 on the Obninsk altitude tower of the Institute of Experimental Meteor-

ology. During daytime, the concentration of radon decay products remains practically constant throughout the layer. In the evening and at night it drops rapidly with increasing altitude from the ground surface up to a height of 50–75m. (auth)

15419 (TT–74-50011, pp 361-371) NATURAL SNOWFLAKE RADIOACTIVITY DUE TO SHORT-LIVED RADON DECAY PRODUCTS. Avramenko, A. S.; Makhon'ko, K. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The paper discusses snowflake radioactivity due to short-lived products of radon decay. Nuclear photoplates of the A-2 type were used as indicator. Of the 3,106 snowflakes measured, 1,270 were radioactive. The frequency of the specific radioactivity of snow flakes has two maxima, at C = 0 and at C = 16 to 32 · 10^3 α-tracks per gram, and one minimum at C = 4 to 8 · 10^3 α-tracks per gram. The number of nonradioactive snowflakes and the specific snowflake radioactivity decreases with increased snowflake mass. A scheme for the radioactivation of snowflakes in order to examine the patterns obtained is also discussed. The coagulation constant of radioactive aerosols with the cloud elements is assessed from experimental data on the number of nonradioactive snowflakes. (auth)

15420 (TT–74-50011, pp 372-379) TRACE ELEMENTS AND NATURAL RADIOACTIVITY IN CLOUD WATER AND ATMOSPHERIC PRECIPITATION IN THE CENTRAL CAUCASUS MOUNTAINS. Makhon'ko, E. P.; Avramenko, A. S.; Makhon'ko, K. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Total concentrations of short-lived radon decay products in precipitation, cloud water and air were measured in summer on the Terskol peak of the Central Caucasus, along with the concentrations of Fe, Pb, Mn, Ni, and Mg. The precipitation samples were taken in polyethylene vessels, the cloud-water samples were taken with the aid of a battery of four parallel cyclones, while the atmospheric aerosol samples were taken by means of a filtering setup with an FPP-15–1.5 filter. The admixture concentrations obtained are similar in the precipitation and the cloud water, as are the corresponding coefficients of admixture concentration (concentration ratios of water to air), i.e., the contamination of precipitation takes place mainly in the cloud. The assessed "lifetimes" of the trace elements in the atmospheric layer subjected to precipitation washout (1.4 days), concentration coefficient (6 · 10^5), and rate of "wet precipitation" (1.2km/day) correspond approximately to the values for natural radioactivity (2 · 10^5 and 0.8km/day), and with literature data for macroelements and nuclear explosion products. This is an indication that the aerosol carriers of these admixtures in the atmosphere have similar properties, mainly similar particle sizes. (auth)

15421 INFLUENCE OF NONSTATISTICAL VARIATIONS ON LOW-LEVEL ^{131}I MEASUREMENTS. Matuszek, J. M. (New York State Dept. of Health, Albany). Trans. Amer. Nucl. Soc.; 18: 49-50(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15422 COMMENTS ON THE AUTORADIOGRAPHIC METHOD FOR OBTAINING PARTICLE SIZE DATA OF PLUTONIUM AEROSOLS. Sundararajan, A. R.; Deworm, J. P.; Berckmans, S. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Health Phys.; 27: No. 1, 137-139(Jul 1974).

A study was carried out to check the validity of the assumption that there is no attachment of plutonium particles to larger dust particles which is made when particle size analysis of plutonium aerosols is carried out using alpha autoradiographic techniques. It was found that the assumption may not be valid in most of the operating areas. Thus the autoradiographic technique does not necessarily give the actual aerodynamic diameter, a parameter which is essential for assessing the inhalation exposure. Therefore the results obtained either with the autoradiographic technique or the autoscintigraphic technique should be used with caution. (UK)

15423 PLUTONIUM AEROSOL SIZE CHARACTERISTICS. Elder, J. C.; Gonzales, M.; Ettinger, H. J. (Los Alamos Scientific Lab., NM). Health Phys.; 27: No. 1, 45-53(Jul 1974).

Field sampling in three AEC plutonium processing plants has provided size characteristics and activity concentrations of plutonium aerosols generated by a variety of research, production and recovery operations. These data provide basic information for the design and testing of air cleaning systems for plutonium plants. Isokinetic sampling with eight-stage impactors immediately upstream of process ventilation exhaust HEPA filters collected particles representing "worst normal" challenge aerosols. Where particle diameters met established statistical criteria for a log normal distribution, activity median aerodynamic diameter (amad) and geometric standard deviation (σ_g) were determined by a least squares computer fit of the cumulative radiometric data vs impactor stage effective cutoff diameters. Amad's varied from 0.10 μm to 11.0 μm and σ_g's from 1.5 to 9.0. All impactor data, including size distributions which were apparently non-log normal, were treated on a stage-by-stage basis (i.e., mean fraction of total activity deposited on a given stage). A Pu recovery plant produced the smallest aerosol encountered, with the size range under 1 μm containing over 70% of total activity. Fabricating plants produced a larger aerosol with over 50% of total activity associated with particles in the 1 to 5 μm range. Research and development facilities produced a broader spectrum of particle sizes, predominantly in the 1 to 2 μm range. Details of these results and a description of sampling, data handling and statistical techniques are presented. (auth)

15424 INFLUENCE OF MINERALIZATION OF RAINFALL AND SNOWFALL ON THE SPECIFIC RADIOACTIVITY. Kwapulinski, J. (Instytut Kształtowania Środowiska, Katowice, Poland). Nukleonika; 19: No. 4, 347-353(1974). (In Polish).

The reciprocal dependence was discovered between the rainfall and snowfall specific radioactivity and mineralization. The negative sign of the correlation factor results. Two directions of the variation in specific radioactivity have been found depending on mineralization. (auth)

15425 METHODS FOR ROUTINE CONTROL OF TRITIUM CONCENTRATION IN AIR MOISTURE IN THE LABORATORY. Florkowski, T.; Nawalany, M. (Inst. of Nuclear Technique, Krakow). Nukleonika; 19: No. 4, 329-335(1974).

Routine control of tritium concentration in air moisture is important in low-level counting tritium laboratory in order to avoid possible contamination of samples. Also in laboratories dealing with high activities in various forms such control is necessary for radiological protection. Methods are described for quick and continuous sampling of air moisture. The last method is based on the exchange reaction of water molecules between sampling pan and air moisture. Relation between residual water volume and tritium concentration in air moisture is calculated and practical conclusions for routine sampling and liquid scintillation counting are given. (auth)

15426 FIRST RESULTS OF A SURVEY OF AIRBORNE RADIOACTIVITY IN ITALIAN MINES. Bottino, A.; Lembo, G.; Scacco, F.; Sciocchetti, G.; Tagliati, S. (CNEN, Casaccia, Italy). pp 217-223 of Proceedings of the Regional Conference on Radiation Protection. Vol 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

An initial investigation of the airborne radioactivity in Italian nonuranium mines was carried out. Data on ^{222}Rn and daughter product concentration are reported for sixteen nonuranium and for two prospecting uranium mines. Values of equilibrium radon concentration are also given. (auth)

Soil

15427 (TT–74-50011, pp 61-66) ACCUMULATION OF STRONTIUM-90 IN SOILS. Tyuryukanova, E. B. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A very uneven distribution of ^{90}Sr is observed in the soils of the Russian Plain. The content of this radioactive nuclide in sandy soils is lower than in loamy soils, and depends on the amount of soil humus and its qualitative composition. The accumulation of ^{90}Sr in soils is determined both by its physicochemical composition, and by the landscape and geochemical conditions. Of great importance is the character of the runoff. In most soils ^{90}Sr is concentrated in the upper layer (0–5 to 0–20 cm). (auth)

15428 (TT–74-50011, pp 67-71) CESIUM-137, STRONTIUM-90, AND LEAD-210 IN SOIL OF THE FAR NORTH REGIONS. Troitskaya, M. N.; Ibatullin, M. S.; Litver, B. Ya.; Nizhnikov, A. N.; Ramzaev, P. V.; Teplykh, L. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The part played by soil in the pollution of subsequent links of the chain of natural and artificial radionuclides in regions of the Far North is considered. It is shown that while a geographic variation exists of the levels of artificial contamination of the soils, the ratio of cesium-137 to strontium-90 in all regions remains between 1.3 and 1.6. Experimental data are given on the mechanism governing the contamination of lichen (the main fodder of reindeer) by natural and artificial nuclides. An analysis is given

of museum samples (1900–1945), indicating the absence of any connection between the high levels of lead-210 in the North and nuclear tests. The levels of plutonium-239 content in the vegetation of some regions of the Far North are determined. (auth)

15429 (TT–74–50011, pp 72-75) COMPARATIVE DISTRIBUTION OF STRONTIUM-90 AND CESIUM-137 IN DIFFERENT TYPES OF SOILS. Belova, E. I.; Antropova, Z. G. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Results are presented of investigations into the distribution of strontium-90 and cesium-137 along the profile of five types of virgin soil 10 years after their contamination. The investigations were conducted under natural conditions on artificially contaminated plots of sod podzolic, gray forest, leached chernozem, meadow solod, and solonchak soils. It is shown that by the tenth year some characteristic features are observed in the distribution of the investigated radioisotopes along the profile of different types of soils. The influence of the forest cover on the migration rate and distribution of radioisotopes along the soil profile is noted. The soils are arranged in the following series according to the content of cesium-137 in the upper layer (0–4 cm): meadow solod < sod podzolic < gray forest < solonchak < leached chernozem. The series for strontium-90 content is as follows: meadow solod < sod podzolic < solonchak < gray forest < leached chernozem. (auth)

15430 (TT–74–50011, pp 76-84) DISTRIBUTION AND MIGRATION OF STRONTIUM-90 IN SOILS. Gedeonov, L. I.; Rosyanov, S. P.; Vinogradova, V. K. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Results are given of a study of ^{90}Sr distribution along soil profiles. This enables the radioactive contamination of the soil cover and the rate of ^{90}Sr migration deep into soil to be estimated. These data can be used in an attempt to study the mechanism of ^{90}Sr migration in soil. Soil samples taken at depths down to 30 cm were subjected to radiochemical analysis for ^{90}Sr. It was found that ^{90}Sr in 1964–1965 was mainly retained in a 15-cm soil layer. Measurable amounts of ^{90}Sr were found in the 25–30-cm layer. The distribution of ^{90}Sr along the profile of loamy soils can be described in a first approximation by a power law. Calculations with its aid show that ^{90}Sr penetrates deeper than 40–60 cm. The motion of radioactive fission products inside the soil cover involves a combination of different physicochemical processes in the soil, the most important of which are ^{90}Sr migration by diffusion and isotope migration together with the soil solution. The dependence of the rate of ^{90}Sr diffusion on the soil moisture content and temperature was determined. It was found that the diffusion coefficients in chernozem and sod podzolic soils for yearly averages of the moisture content are $0.49 \cdot 10^{-7}$ and $0.84 \cdot 10^{-7}$ cm^2/sec, respectively. The vertical distribution of ^{90}Sr in soils resulting from diffusion alone was calculated with the aid of the coefficients found. Comparison of the calculated distribution of ^{90}Sr with the distribution obtained by radiochemical determination of ^{90}Sr showed that in loamy chernozem ^{90}Sr migrates mainly by diffusion. In sandy sod podzolic soil this process is of the same order as the others. (auth)

15431 (TT–74–50011, pp 239-244) ASSESSMENT OF RADON EMANATION FROM THE SURFACE OF EXTENSIVE TERRITORIES. Sisigina, T. I. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

A method of assessing radon emanation from a surface covered by one type of soil, under uniform and stable conditions (dry weather, constant barometric pressure, weak wind below 3 m/sec) is discussed. The results of comprehensive observations are examined, including measurements of the flux density of radon from the soil surface into the atmosphere, of radon concentration in the soil profile to a depth of 2 m, emanation factors and radium content in the soil, and the determination of soil porosity and water content. Based on experimental data obtained at about 40 different locations in European USSR, a correlation was established between radium content in the surface soil layer and radon emanation into the ground layer of the atmosphere. For convenience, specific emanation factor β (i.e., the radon flux density due to unit radium concentration in the soil) is introduced. Factor β is calculated from measurements at different points, but on soils of similar mechanical composition, and diverges 8 to 10% from its average value for the given soil type; typical values are $1.8 \cdot 10^{-5}$ (for sandy soil) and $3.7 \cdot 10^{-5}$ Ci/km^2·sec·g Ra·g^{-1} (for highly-textured gray forest and light chestnut loams). For the territory bounded by the latitude of Leningrad to the north and the Northern Caucasus foothills to the south, the weighted-mean radon flux density into the atmosphere is $E_{w.m} = 24 \cdot 10^{-3}$ Ci/km^2·sec. For the northern part of this territory, half of which is covered by sands and sandy loam, $E_{w.m} = 19 \cdot 10^{-3}$ Ci/km^2·sec. In the southern part, with widespread, highly textured and strongly emanating chernozems and chestnut soils, $E_{w.m} = 30 \cdot 10^{-3}$ Ci/km^2·sec. (auth)

15432 DIRECTIONAL NEUTRON FLUX SURVEY OF ACTINIDE WASTE TRENCH. Bruns, L. E.; Weil, S. R. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 52-53(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15433 ADSORPTION AND EXTRACTION OF ^{85}Sr AND ^{137}Cs IN FINNISH SOILS. Hakkinen, U. L.; Lakanen, E. (Agriculture Research Centre, Tokkurila, Finland). pp 249-258 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Investigations on the adsorption and extraction of ^{85}Sr and ^{137}Cs in Finnish top soils show that both nuclides are strongly adsorbed by mineral soils. The adsorption of ^{85}Sr in organic soils is also high, whereas ^{137}Cs adsorbed is considerably lower in organic soils than in mineral soils. Acid ammonium acetate extracts a large part of adsorbed ^{85}Sr from mineral soils; extraction from organic soils is lower. ^{137}Cs extraction from mineral soils is only between one quarter and a half of the corresponding ^{85}Sr extraction, whereas ^{137}Cs extraction from organic soils is of same order or higher than ^{85}Sr extraction from the same soils. From regression analysis studies it was found that the adsorption of ^{85}Sr and ^{137}Cs increases and their extraction decreases in most soil groups with increasing clay content, pH-value, and exchangeable calcium and potassium. Increasing organic-matter content increases ^{85}Sr adsorption and decreases its extraction, whereas the opposite is true for ^{137}Cs. (auth)

Water

Refer also to abstracts 15373 and 15531.

15434 (COO-3566-10) DISTRIBUTION OF SOME CHEMICAL ELEMENTS BETWEEN DISSOLVED AND PARTICULATE PHASES IN SEA WATER. Progress Report, August 1, 1973–July 31, 1974. (Woods Hole Oceanographic Institution, Mass. (USA)). 1974. Contract AT(11-1)-3566. 19p. Dep. NTIS $4.00.

A second cruise to the Cariaco Trench off Venezuela was carried out to complete anoxic basin studies initiated earlier. Sampling was completed and analysis started for a study of ^{210}Pb and ^{210}Po in both dissolved and particulate states in a transect of the equatorial Northern Atlantic Ocean. (MCG)

15435 (COO-3568-4) PLUTONIUM AND AMERICIUM CONCENTRATION ALONG FRESH WATER FOOD CHAINS OF THE GREAT LAKES, U. S. A. General Summary of Progress, 1973–1974. Bowen, V. T. (Woods Hole Oceanographic Institution, Mass. (USA)). 1974. Contract AT(11-1)-3568. 47p. Dep. NTIS $5.50.

Samples of water, sediments, and biological materials were collected and analyzed for radioisotopes. Tables are presented to show results of radiochemical analyses of water for ^{137}Cs, ^{239}Pu, and ^{90}Sr; of sediments for ^{137}Cs, ^{239}Pu, ^{240}Pu, and ^{90}Sr; of fish and plankton for ^{137}Cs, ^{239}Pu, and ^{240}Pu; and of shoreline plants for ^{241}Am, ^{137}Cs, and ^{239}Pu. (HLW)

15436 (TT–74–50011, pp 29-36) DETERMINATION OF RADIOISOTOPE FALLOUT FROM ITS CONTENT IN CHRONOLOGICAL LAYERS OF HIGH-ALTITUDE GLACIERS. Davydov, E. N.; Makhon'ko, K. P.; Tsevelev, M. A.; Shulepko, Z. S. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The contents of ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{54}Mn, ^{106}Ru, and ^{210}Pb are determined in chronological layers of neve and ice in high-altitude glaciers of the Caucasus and Tyan-Shan. The annual fallout of ^{137}Cs determined by means of a cuvette-type collector agrees satisfactorily with the fallout determined from the ^{137}Cs content in the chronological layers of the glacier in the period 1963–1967. A similar comparison for ^{90}Sr in the period 1956–1967 showed that the proportion of ^{90}Sr contained in the chronological layers of these glaciers is about 10% of the atmospheric fallout of the isotope, which corresponds roughly to the proportion of Sr existing in indissoluble form. It is shown that about 90% of ^{90}Sr and roughly 40% of ^{210}Pb, falling on the glacier surface from the atmosphere, are eliminated together with the melted snow, while ^{137}Cs hardly migrates at all. The time variation in the fallout of different

isotopes, determined from their content in chronological layers of the glaciers, led to the following value for the half-removal period of isotopes of fission products from the atmosphere: $T_{1/2} \sim 11$ months. The figure for ^{54}Mn is $T_{1/2} \sim 28$ months. (auth)

15437 (TT-74-50011, pp 85-87) HORIZONTAL WATER MIGRATION OF STRONTIUM-90. Vodovozova, I. G. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

During spring snowmelting, radioactive strontium deposited on the earth's surface participates with melted snow in migration processes. Data are presented on the physicochemical state of strontium-90 migrating with water; 73% of strontium-90 falling with snow is in cationic form. Atmospheric precipitation is deposited in the soil, participates in the migration processes, and subsequently leaches mainly soluble strontium-90 from the soil and its proportion in cationic form in the melted snow and river water increases to 100%. Existing in an easily mobile cationic form, strontium-90 is discharged in the river together with floodwaters. (auth)

15438 RADIOLOGICAL POLLUTION OF WATER SUPPLIES. Kshirsagar, S. B. (Central Public Health Engineering Research Inst., Bombay). J. Inst. Eng. (India), Public Health Eng. Div.; 52: No. 2, 9-12(Oct 1971).

The effects of radioactive pollution of water supplies on health are briefly summarized. Standard methods of examination of samples of water are described. Tables are presented giving selected radionuclides and their critical organs and permissible concentrations of these nuclides in water for domestic use as laid down by ICRP rules. Methods for decontamination of water are outlined. The need for vigilance and prevention of contamination is emphasized. (INIS)

Ecosystems and Food Cycles

Refer also to abstracts 14748, 14837, 14845, 15374, and 15983.

15439 (FOA-4-4573-A3) TRANSFER OF SIMULATED FALLOUT PARTICLES FROM PASTURE TO GRAZING DAIRY CATTLE. IV. Further Experiments with Wet and Dry Deposited 100 to 200 μm Particles and Wet Deposited 1 μm Particles. Ekman, L.; Eriksson, A.; Greitz, U. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Apr 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

The transfer of simulant fallout particles from pasture to grazing cows has been studied in nine field experiments. The experiments were performed with wet and dry deposited 100 to 200 μm particles and with wet deposited 1 μm particles labeled with ^{141}Ce and ^{140}La. The fraction of deposited material ingested by the animals was assessed by assay of the radioactivity content in feces. On the average 14 (range 4 to 28) per cent of the wet deposited 100 to 200 μm particles was consumed by the grazing cows. During the time period 1969 to 1972 a total of 21 experiments with wet deposited 100 to 200 μm particles were carried out. A mean initial retention of 16 (range 4 to 28) per cent can be calculated from all these studies. Based on these three year experiments it seems reasonable to assume that the initial retention of close-in fallout deposited in connection with precipitation will vary between 4 and 28 per cent. The retention of dry deposited 100 to 200 μm particles was studied in four experiments. On the average 11 (range 4 to 23) per cent of deposited amounts was consumed by cows. Based on a total of eight experiments carried out 1971 to 1972 it was found that on the average 9 (range 1 to 23) per cent was consumed. On the average 37 (range 12 to 60) per cent of deposited 1 μm particles was recovered in feces of the cows. To get some information on the retention of the particles on the grass deposition occurred on two adjacent pens simultaneously. On one pen the cows started grazing immediately after deposition and on the other pen five days after deposition. No definite conclusion could be drawn from the limited number of experiments carried out to study the retention of fallout simulant particles on the grass a few (five) days after deposition but the results suggest that the field loss of particles has been surprisingly small. (auth)

15440 (INIS-mf-1134) ^{90}Sr ABUNDANCE IN ADULT BONE TISSUE AND IN TEETH OF DIFFERENT-AGE PATIENTS. Prokof'ev, O. N.; Dzyubenko, I. I.; Dikaya, E. Ya.; Valushkina, N. I.; Antonova, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 8p. (In Russian). INIS.

Data obtained from human bones and teeth in several Russian cities showed an unexplained decrease in the ^{90}Sr content of adult skulls, teeth, and ribs from 1966 to 1969. In teeth extracted before patients were 7 years old the ^{90}Sr increased from 600 pCi in 1965 to 1200 pCi in 1969. In those from patients from 8 to 9 years old and from 10 to 13 years old the increase was less. In 1961-1962, before the greatest contamination of foods, ^{90}Sr in children's teeth was 5 times that in adults. Therefore the ^{90}Sr in bone tissue and bone marrow is higher than in adults but about the same amount. (tr-auth)

15441 (RLO-2227-T-12-43) ECOLOGICAL STUDIES OF RADIOACTIVITY IN THE COLUMBIA RIVER ESTUARY AND ADJACENT PACIFIC OCEAN. Progress Report, July 1, 1972-March 31, 1974. Cutshall, N. H. (Oregon State Univ., Corvallis (USA). School of Oceanography). Apr 1974. Contract AT(45-1)-2227. 24p. Dep. NTIS $4.25.

Progress is reported on studies of radionuclide transport in the Columbia River estuary and adjacent Pacific Ocean following the shutdown of the Hanford production reactors in 1971. Emphasis is placed on the content of ^{65}Zn and ^{54}Mn in benthic fishes and their prey and in fresh water molluscs. Computer programs were developed for analysis of the data. (CH)

15442 (TID-26600) RADIOACTIVE FOODCHAINS IN THE SUBARCTIC ENVIRONMENT. Technical Progress Report, August 15, 1973-August 14, 1974. Miettinen, J. K. (Helsinki Univ. (Finland). Dept. of Radiochemistry). May 1974. Contract AT(11-1)-3011. 78p. Dep. NTIS $7.00.

Separate abstracts were prepared for the six sections of this report. (CH)

For abstracts of individual sections see: 15443-15447 and 15983.

15443 (TID-26600, pp vp, Paper 58) FALLOUT LEVELS OF ^{137}Cs IN FINNISH LAPLAND DURING 1966-1973 IN THE FOOD-CHAIN LICHEN-REINDEER-MAN. Preliminary Report. Rahola, T.; Miettinen, J. K. May 1974.

In radioactive foodchains in the subarctic environment.

Results obtained from measurements of the ^{137}Cs content of lichen, reindeer organs, and the body burden of Finnish Laplanders between 1966 and 1973 are presented. These results are then compared with those reported from other northern regions. The radiation doses originating from ^{137}Cs are estimated and compared with those received by Lapps and southern Finns from other internal and external sources of radiation. (auth)

15444 (TID-26600, pp vp, Paper 59) BODY BURDEN OF ^{137}Cs IN FINNISH LAPPS IN MARCH 1974. Preliminary Results. Rahola, T.; Jaakkola, T.; Miettinen, J. K. May 1974.

In radioactive foodchains in the subarctic environment.

Measurements of the ^{137}Cs body burden of a group of mountain Lapps (Inari and Utsjoki) and Skolts (Nellimö and Sevettijärvi) of various occupations were carried out in March 1974 as in the previous years since 1962. The measurements were carried out by the same ambulatory whole-body counting laboratory as in the previous years. The average in all Lapps, 161 nCi ^{137}Cs/person, was 78.5% of the value (205 nCi) measured in these individuals in 1973. This decrease (21.5%) is slightly greater than in all Lapps in the previous year (16%), however, the decrease of men now (22.3%) is almost the same as that of the reindeer herders last year (25%). (auth)

15445 (TID-26600, pp vp, Paper 60) RADIONUCLIDES IN PLANTS (1973) AND REINDEER MUSCLE (1974) FROM FINNISH LAPLAND. Preliminary Report. Rahola, T.; Miettinen, J. K. May 1974.

In radioactive foodchains in the subarctic environment.

Plant samples collected from the Inari, Finland, sampling location were analyzed for ^{137}Cs content by gamma spectrometric method. The ^{137}Cs content in lichen was low at this sampling location and representative only when comparing with the values from 1972. No short-lived gamma nuclides were observed in samples collected during the summer of 1973. Reindeer muscle samples were collected in Dec. 1973 to Mar. 1974 and gamma counted in April 1974. The ^{137}Cs average value was 21 nCi/kg fresh wt, whereas it was 27 nCi/kg fresh wt in 1972. (CH)

15446 (TID-26600, pp vp, Paper 62) PLUTONIUM IN LICHEN IN FINLAND DURING 1960-1973. Tulikoura, J.; Jaakkola, T.; Miettinen, J. K. May 1974.

In radioactive foodchains in the subarctic environment.

The accumulation and residence time of plutonium produced by nuclear tests in lichen and the ratio of ^{238}Pu to $^{239,240}Pu$ in lichen was determined. The lichen samples analyzed were collected in Finland during 1960 to 1973. (CH)

15447 (TID-26600, pp vp, Paper 63) PLUTONIUM IN REINDEER LIVER IN FINNISH LAPLAND DURING 1964-1973. Preliminary Results. Mussalo, H.; Jaakkola, T.; Miettinen, J. K. May 1974.

In radioactive food chains in the subarctic environment.

The content of fallout plutonium (^{238}Pu, ^{239}Pu, and ^{240}Pu) in reindeer, which is the second link in the food-chain lichen-

reindeer—man in Finnish Lapland was measured. The plutonium analyses of reindeer organs and tissues were started by analyzing 23 liver samples representing 43 animals of different age and sex. The samples were collected in Finnish Lapland during the period of 1964–1973. Because liver plays an important role in metabolism of plutonium in animals, liver was chosen as the first material to be analyzed. Reindeer liver is probably the most important source of plutonium in Lapps' diet. Dried liver samples (20 to 40 g of dry wt) were wet ashed with nitric and hydrochloric acid, ^{242}Pu tracer was added, and samples were ignited at 600°C. The ash was leached with mixture of nitric acid and hydrochloric acid. The isolation of plutonium was started with anion-exchange (nitrate form). The eluate was adjusted to 8 N in HCl and iron was extracted with diisopropyl ether. Another anion-exchange (chloride form) was performed, and plutonium was electrodeposited on a platinum disc. The α-activity of plutonium was determined using a surface barrier semiconductor and a 512-channel pulseheight analyzer. The accumulation and residence time of plutonium produced by nuclear tests in lichen samples collected during 1960 to 1970 and the ratio of ^{238}Pu to $^{239,240}Pu$ in lichen was also determined. (CH)

15448 RELATIONSHIP BETWEEN THE PHYSICO-CHEMICAL FORM OF RUTHENIUM-106 AND CONTAMINATION PHENOMENA OBSERVED EXPERIMENTALLY IN VARIOUS MARINE SPECIES. Fraizier, A. (Centre de la Hague, Cherbourg, France). pp 135-148 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Research is being carried out on contamination mechanisms in connection with contamination vectors, the properties of the contaminant, and the contaminated support. The experiments involve contamination of five marine species, Corallina officinalis, Chondrus crispus, Palaemon serratus, Mytilus edulis, and Pleuronectes platessa, by various physico-chemical forms of ruthenium-106, i.e. insoluble polymerized forms, and soluble (anionic, cationic or neutral) forms. Contamination is faster and from 2 to 12 times greater, depending on the species, with the insoluble polymerized forms than with the soluble forms. In a given contaminated environment, and in the case of certain animal species (plaice and mussels in particular), an initial ascending phase of contamination is observed to be followed by a phase of partial rejection, especially in respect of the polymerized forms. However, this phenomenon is not seen to occur with algae or mussel shell. The latter exhibits a steady and continuous accumulation of the radionuclide without either a fast initial phase or a rejection phase. (auth)

15449 EXPERIMENTAL STUDIES ON CADMIUM FLUX THROUGH MARINE BIOTA. Fowler, S. W.; Benayoun, G. (International Lab. of Marine Radioactivity, Monaco). pp 159-178 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The role of mussels (Mytilus galloprovincialis) and benthic shrimp (Lysmata seticaudata) in the cycling of cadmium in the marine environment was examined. Results from ^{109}Cd uptake experiments indicated that steady state between water and the organisms was not reached after 2 months. Concentration factors computed at this time were 130 and 600 in whole mussels and shrimp, respectively. Concentration factors based on stable cadmium concentrations were several times higher, indicating incomplete equilibration between ^{109}Cd and stable cadmium in the organisms. Mussels had the highest ^{109}Cd concentrations in the viscera with lesser amounts in muscle, mantle, gills, and shell, respectively. The highest ^{109}Cd concentration in shrimp was also found in the viscera, followed by exoskeleton, muscle, and eyes. Relative differences between stable and radiocadmium content of certain tissues are discussed. Increased cadmium uptake at higher temperatures was noted in shrimp, whereas uptake by mussels was unaffected by temperature. The uptake of cadmium was directly proportional to the cadmium content in seawater; however, accumulation was unaffected by varying the zinc concentration. Shrimp tended to lose cadmium faster at higher temperatures; however, differences were not significant over the 2 months loss period. Shrimp maintained in a flowing seawater system retained an average 55% of their original ^{109}Cd body burden after 8 months. The biological half-life, computed over a 7 month period, was 378 days. The relatively slow loss of ^{109}Cd from mussels was not affected by either the levels of zinc in their tissues or zinc concentration in the surrounding seawater. Mussels maintained at a field station lost significantly less ^{109}Cd than a similar group held in the laboratory flowing seawater system during the first 3 months. After this time field animals fluxed cadmium 4 times faster ($Tb_{\frac{1}{2}}$ = 307 d) than the laboratory group ($Tb_{\frac{1}{2}}$ = 1254 d). The observed discrepancy between flux rates is thought to be related to differences in the organisms' food supply. It is concluded that cadmium flux is a relatively slow process in mussels and shrimp. Animals coming into contact with cadmium polluted waters will retain a significant fraction of the accumulated metal for a relatively long period of time. (auth)

15450 STABLE LEAD AND ^{210}Pb IN THE FOOD CHAIN LICHEN — REINDEER — MAN. Persson, R. B. R. (University of Lund, Sweden). pp 231-247 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Stable lead and the naturally occurring radionuclides ^{210}Pb and its decay product ^{210}Po were studied in the food chain lichen — reindeer — man. The slowly-growing lichen plants of the Cladonia family receive their main nutrients from the atmosphere and show a marked tendency to accumulate and retain deposited fallout products. Samples of lichens collected during the period 1882 to 1972 were analyzed for stable lead and ^{210}Pb. The ^{210}Pb specific activity ($^{210}Pb/Pb$ ratio) indicates a constant value of about 2 mCi/kg up to 1940, and then, in 1950 to 1960, a rapid decrease to 0.6 mCi/kg. As the average annual ^{210}Pb deposition is quite constant, the decrease in the $^{210}Pb/Pb$ ratio indicates an increased general deposition of stable lead after 1940. The concentration of stable lead (μg/kg) and the activity-concentration of ^{210}Pb (pCi/kg) were investigated in the different steps of the food chain lichen — reindeer — man. A detailed study was performed on different organs of reindeer slaughtered in 1970 and 1971. Human blood samples from both Lapps engaged in reindeer breeding and non-Lapps were also analyzed. The average ^{210}Pb-activity concentrations found in lichen (top layer) were 6300 pCi/kg dry weight, in reindeer-bone 5200 pCi/kg wet weight, in kidneys 300, in liver 700, in blood 33 and in meat about 13 pCi/kg wet weight. The ^{210}Pb specific activity in lichen was quite constant at 0.6 mCi/kg and in the reindeer in the order of 0.3 to 0.5 mCi/kg. The ^{210}Pb activity concentration in human blood was about 3 to 5 pCi/kg wet weight and the ^{210}Pb specific activity was 0.02 mCi/kg. A comparative study of the transfer of both ^{210}Pb and stable lead through the food chain was performed by using a compartment model and the concept of fractional residence-time. The results of this study indicate that the ecological behavior of stable lead and radiolead (^{210}Pb) deposited from the atmosphere seems to be identical in the food chain lichen — reindeer — man. (auth)

15451 LONG-LIVED RADIONUCLIDES IN FOOD: ^{90}Sr AND ^{137}Cs IN THE ISRAEL DIET. Feige, Y.; Eisenberg, A.; Proulov, Y.; Klopper, J. (Soreq Nuclear Research Centre, Yavne, Israel). pp 271-279 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Routine monitoring of strontium-90 and caesium-137 levels in the main classes of food consumed in Israel has been carried out for a number of years. Calculations have been made of the intake of these isotopes by various groups in the Israel population using Food Consumption Survey data made available by the Israel Central Bureau of Statistics. More detailed analyses have been carried out to calculate the exposure of groups selected on the basis of demographic, economic, and family-size criteria. This was carried out in an attempt to detect critical groups in the population who might be unusually highly exposed. Results of these data indicate that in the case of Israel the monitoring of a single food item such as milk or the extrapolation of local fallout data cannot be relied on to give an estimate of radionuclide exposure through food. The relation between high consumption groups and the intake of average consumers is discussed in detail, and the use of the statistical models developed in these studies for the estimates of radionuclide exposure during periods of high fallout levels which occurred in the past and possible applications with regard to other environmental contaminants are discussed. (auth)

15452 DISTRIBUTION MODEL FOR RADIOACTIVE AND OTHER PERSISTENT POLLUTANTS IN THE ENVIRONMENT AND IN THE FOOD CHAIN. Zuccaro Labellarte, G. (Comitato Nazionale per l'Energie Nucleare, Rome). pp 585-594 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The paper describes a computerized distribution model for

radioactive and persistent pollutants in the environment and in the human food chain. The study of the distribution of radioactive pollutants released from nuclear plants led to this model, which allows of the calculation of seasonal or annual averages of pollutant concentrations due to stationary or quasi-stationary sources. The model input includes a detailed list of each pollutant released in air, in freshwater and in seawater, the frequency of occurrence of various meteorological conditions during the period of time under consideration, and physical features of the receiving water bodies. The output of the model gives, for each pollutant being considered: (a) its concentration function in each link of the food chain, (b) its source-to-man transfer function for a given population, and (c) its critical pathways. The analogies and differencies in the behavior between radioactive and persistent pollutants are discussed. The model was written in FORTRAN and run on an IBM 360/30 computer. (auth)

15453 FOOD AND ENVIRONMENTAL CONTAMINATION: A SCIENTIFIC APPROACH TO THE PROBLEMS AS A WHOLE. Winteringham, F. P. W.; Marchart, H.; Munn, J. I. pp 603-612 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

This paper outlines the scientific aspects of the problem of foreign chemicals entering the environment and the food chain. It provides a general survey of points of particular interest that were featured in papers or discussions at the FAO/IAEA/WHO Symposium on Nuclear Techniques in Comparative Studies of Food and Environmental Contamination (Helsinki, 1973)—a meeting that served to review inputs, fates and significance of a representative range of chemical and some radioactive contaminants of food and the environment. (auth)

15454 TRACE ELEMENTS IN MILK. Murthy, G. K. (Food and Drug Administration, Cincinnati). CRC Crit. Rev. Environ. Contr.; 4: No. 1, 1-37(1974).

The trace elements in cow's milk, human milk, and infant products, including their relationship to the total diet, are discussed. Sampling procedures and analytical methods are described for monitoring Cu, Fe, Mn, I, Se, Zn, Mo, Co, F, Cr, Al, Cd, Pb, Ni, As, B, Br, Hg, Rh, Ag, Sr, Cr, Si, Ti, and V contents. (177 references). (MCG)

15455 UPTAKE AND ACCUMULATION OF RADIONUCLIDES IN SEAWATER BY PLANKTON. Honda, Y. (Kinki Univ., Higashi-Osaka, Japan); Kimura, Y.; Kitada, H.; Fukumitsu, H. Kinki Daigaku Genshiryoku Kenkyusho Nenpo; 9: 19-24([nd]). (In Japanese).

Phytoplanktons as primary producers play important roles in the cycles of substances in the marine environment. The experimental studies on uptake and accumulation of ^{60}Co, ^{106}Ru, and ^{144}Ce in sea water by dividing Chlorella pyrenoidosa have been conducted. The population growth curves of Chlorella sp. were not affected with a radioactive concentration of about 1.7×10^{-3} Ci/ml of these radionuclides. The uptake and accumulation of ^{60}Co by dividing Chlorella sp. increased with growth and reached an equilibrium state in about 5 to 7 days. Only about 1 to 2% of ^{60}Co in sea water media (in controls) were recovered on Millipore HAWP filters at an equilibrium state. The uptake and accumulation of ^{106}Ru and ^{144}Ce by dividing Chlorella sp. reached peaks in one day, hereafter decreased and then reached equilibrium states in about 7 days. The recovered radioactivities of ^{106}Ru and ^{144}Ce in sea water media (in controls) on Millipore HAWP filters at equilibrium states represented about 3% and 50%, respectively. The concentration factors for ^{60}Co, ^{106}Ru, and ^{144}Ce in Chlorella sp. at equilibrium states were estimated to be about 3×10^2, 2×10^2, and 5×10^3, respectively. (auth)

15456 HYGIENIC STANDARDIZATION OF ^{14}C IN THE ATMOSPHERE. Golenetskii, C. P.; Kolpakov, V. A.; Paderova, V. P.; Peshkov, V. K.; Stepanok, V. V.; Luchinskii, M. M.; Bodrov, L. N.; Skerin, Yu. A. Gig. Sanit.; No. 1, 47-50(Jan 1974). (In Russian).

The PTP (yearly permissible limit) and the CDK (average annual permissible concentration) of ^{14}C recommended do not take into account the chemical form of the isotope, the role of the food chains and the possibility of determining kinetic balance of the specific activity of ^{14}C in the system environment-man in case of systematic action of $^{14}CO_2$ in the biosphere. The concept of the specific activity or that of the CDK is a more objective criterion in standardizing the internal irradiation of the body by basic biogenic radioisotopes in comparison with the conception of the PTP. Experimental tests should be carried out in order to determine relative genetic effect of the isotope ^{14}C on higher animals. (auth)

15457 EFFECT OF CULINARY TREATMENT OF MEAT PRODUCTS ON THE PASSAGE OF ^{137}Cs INTO THE COOKED DISHES. Pakulo, A. G.; Rapina, E. G. Gig. Sanit.; No. 1, 96-97 (Jan 1974). (In Russian).

During boiling of meat containing ^{137}Cs more than 70% of it is transmitted to the broth. Removal of the broth and use of only the boiled meat makes it possible to reduce significantly the intake of ^{137}Cs into the human organisms which can have a practical value in the case of intense contamination of meat products by isotopes. (tr-auth)

15458 RAPID ACCUMULATION OF PLUTONIUM AND POLONIUM ON GIANT BROWN ALGAE. Hodge, V. F.; Hoffman, F. L.; Folsom, T. R. (Scripps Institution of Oceanography, La Jolla, CA). Health Phys.; 27: No. 1, 29-35(Jul 1974).

Young blades of the giant brown marine alga Macrocystis, are shown to be potential monitors of rapid changes in coastal sea water plutonium concentrations. Choosing blades of the same age, and normalizing their activities to unit surface area, rather than weight, provide a method for monitoring plutonium trends with time. When greatest sensitivity is required, a factor of 4 may be gained by choosing the oldest blades. Polonium and plutonium accumulate on surfaces of several algae in a ratio of about 200. Small surface living animals, bryozoans, build up polonium with preference to plutonium by 1000, and have activity concentrations only 50 times less than the 75,000 pCi/kg typically found in the pyloric caeca of large marine fish. (auth)

15459 BIOLOGICAL CONCENTRATION OF RADIOACTIVE MATERIALS IN THE ENVIRONMENT. Shimizu, M. (Tokyo Univ.). Gamma Field Symp.; 22: No. 11, 662-673(Nov 1973). (In Japanese).

With the concentration of radioactive materials in the organism as a parameter for the evaluation of the effect of radioactive materials on the ecological system, quantitative methods for expressing the concentration are discussed with special reference to data on marine organisms published during 1937 to 1973. Concentration factor (CF) is used for predicting the effect of radioactive nuclides discharged into a non-polluted sea area. There are differences in CF in the environments which are not constant (the mouth of a river, rivers, etc.), necessitating examination of the conditions under which CF was obtained, and CF differs by the type of organisms and by organ and tissue even in the same species. It fluctuates due to intrinsic factors such as the physiological activity of organisms and extrinsic factors such as salt, water temperature, and pH. The metabolism of nuclides is influenced by the physical and chemical forms also. In aquatic animals, nuclides are incorporated from water through food and the epithelial tissue, and the necessity of elucidating the incorporation through food in relation to the food chain is pointed out. The specific activity used for the evaluation of the effect of pollution over a wide range is based on the assumption that the distribution of artificial radioactive nuclides becomes equal with that of natural stable isotopes, but this situation is difficult to attain in reality. Discrimination factor (observed ratio) was used for evaluating ^{90}Sr in the food chain of aquatic and terrestrial animals. An attempt was made to correlate the fallout level of ^{90}Sr with the volume of accumulation on the ground and the fallout rate and to relate the amount of ^{90}Sr in the environments to that in food. (JA)

15460 BETA RADIOACTIVITY OF PERIPHYTON IN CERTAIN DAM RESERVOIRS. Kwapulinski, J. Acta Hydrobiol.; 14: No. 3, 273-286(1972).

Surface waters, including their organisms, can be contaminated with natural or artificial isotopes introduced into the biosphere for economic or scientific purposes or with radioisotopes originating from atomic explosions. Accumulation of radioactivity by periphyton can cause recontamination of water. Periphyton from three dam reservoirs in Poland was investigated for β radioactivity. In one reservoir measurements were carried out between 1966 and 1968; in the other reservoirs they were taken in 1968. The cumulation coefficient in these reservoirs was on the order of 10^3 to 10^4. During the summer peak of water contamination, periphyton demonstrated maximum radioactivity. The radioactivity of the periphyton illustrates the general conditions of the water in a given layer of the reservoir. (Pollut. Abstr.)

15461 ECOLOGICAL ANALYSIS ON LOW-LEVEL RADIOACTIVE WASTES CENTERING AROUND TRITIUM AND KRYPTON. Fujita, M. (Japan Atomic Energy Research Inst., Tokai). pp 253-286 of Siting and Environmental Problems in the Development of Electric Power Stations. Its Status and Analysis. Tomioka, K. (Ed.). Tokyo; Fuji International Co. (1973). (In Japanese).

The movement of radioactive wastes through the environment to the human body, methods for calculation of the exposure dose to man from tritium and ^{85}Kr, and radiation injury of the human

body are described, especially emphasis on the uptake of tritium and ^{85}Kr. When radioactive wastes are discharged into environment, they reach the human body directly, or through food chains involving soil, vegetables and grains, or animals, and the human body is subjected to external exposure or internal exposure. As for the ^{85}Kr, only the external exposure should be considered, whereas when tritium is discharged into sea, atmosphere, or underground, it is taken up by plants and animals. For the calculation of exposure dose of the human body surrounded by air containing ^{85}Kr, equations by ICRP, Hendrickson, and Adams have been proposed. On the other hand, for the calculation of exposure dose when tritium water is taken into the human body, a single compartment model and three compartment model have been employed. At present, data on the injury of human body is not available regarding exposure to ^{85}Kr. Two cases of death have been reported following exposure to tritium. As to the effects of radiation on the human body, there are somatic effects and genetic effects. Dose limits are given by ICRP and NCRP respectively. The ratio of biological effect of tritium was determined as 1.0 by ICRP in 1969. (JA)

15462 DAILY FEEDING RATES OF BLUEGILL (LEPOMIS MACROCHIRUS) DETERMINED BY A REFINED RADIOISOTOPE METHOD. Kolehmainen, S. E. (Oak Ridge National Lab., TN). J. Fish. Res. Board Can.; 31: No. 1, 67-74(Jan 1974).

The daily values of ^{137}Cs intake by bluegill (Lepomis macrochirus) from a small impoundment receiving low-level radioactive effluents were used to calculate the daily feeding rates of the fish. The ^{137}Cs concentration in fish, and the temperature-elimination rate were calculated. The feeding rates were obtained by dividing the daily intake of ^{137}Cs by the concentration of ^{137}Cs in the diet. The daily meal of bluegill varies from 0.8% of body weight in February to 3.2% in June with an annual mean of 1.75%. There was a positive correlation between the daily meal and the daily temperature. The ecological growth efficiency was 4.2% during the period from April to October. (auth)

Radiometric Techniques

Refer also to abstracts 14741, 14748, 15367, 15539, 16074, 16075, 16108, and 18108.

15463 (STI/PUB-349) ISOTOPE AND RADIATION TECHNIQUES IN SOIL PHYSICS AND IRRIGATION STUDIES 1973. Proceedings Series. Proceedings of a Symposium Held in Vienna, Austria, October 1-5, 1973. (International Atomic Energy Agency, Vienna (Austria)). Mar 1974. 525p. (In French and English). (CONF-731010-). IAEA $22.00.

Thirty-three papers were presented. A separate abstract was prepared for each of 32 papers. One paper was not within the scope of NSA. (LCL)

For abstracts of individual papers see: 15354, 15482-15511, and 16108.

15464 (TT-74-50011, pp 40-41) CHARACTERISTICS OF UPPER CLOUDS AND SUGGESTIONS REGARDING THE UTILIZATION OF RADIOACTIVE TRACERS IN MERIDIONAL FLOWS. Romanov, N. N. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The analysis of numerous reports of aircraft pilots and observations during research flights in TU-104 and IL-18 aircraft lead to the establishment of a relationship between the development of upper clouds and the direction of wind with a large meridional component. Independently of the character of the baric field, the clouds develop under southern and southwestern stable flows and are destroyed (or are absent) by northern and northeastern flows. This relationship is expressed more strongly in low latitudes and is weaker in high latitudes. It is assumed that such a relationship results from stable vertical currents of positive or negative sign, appearing in meridional flows on the rotating Earth. It is suggested that direct measurement of vertical motions be conducted with the aid of radioactive tracers during a rationally selected synoptic situation. (auth)

15465 (TT-74-50011, pp 42-56) MEAN AND TURBULENT TRANSFER OF SUBSTANCES OVER THE USSR. Guterman, I. G. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The relation is examined between the mean and turbulent fluxes of substances at the limit of the atmospheric boundary layer (1.5 km) in January and July over the USSR. It is shown that the intensity of macroturbulent fluctuations, characterized by the ratio of the vectorial standard deviation of wind σ_v to the modulus of the resultant wind $|\bar{V}_r|$, is equal to 100-500% in winter and 200-2,000% in summer. This results mainly from the decrease in mean transfer, since the macroturbulent component of the motion σ_v in summer is of the same order as in winter. Turbulent heat fluxes in January hardly attain 1-3% of the fluxes due to the mean motion, while in July this ratio increases to 4-7%. Therefore, the practically horizontal heat fluxes at that level can be calculated from data on the mean temperature and resultant wind. The streamlines of turbulent heat fluxes coincide with the direction of the temperature gradient and, over the USSR in both January and July, are generally opposite to or intersect at right angles the streamlines plotted on the basis of the average wind speed vector. Hence the total heat fluxes are vectorially somewhat smaller than the mean heat fluxes. Horizontal turbulent moisture fluxes make a more important contribution to the total moisture flux. At 1.5 km, the ratio of the turbulent moisture flux to the moisture carried by the mean motion fluctuates between 20 and 180%, and in July between 40 and 140%. Over the USSR, within a single season the regions of increased and reduced turbulence of the fluxes of the three considered substances coincide roughly, although the relative annual range of fluctuations for the different substances is different. The direction of the turbulent moisture fluxes almost coincides with that of the horizontal gradients of mean absolute humidity. Over the USSR we isolated regions where the turbulent moisture fluxes are integrated with the mean moisture fluxes, and, on the other hand, regions where the total moisture fluxes are weakened sharply as a result of oppositely directed fluxes of the two kinds. (tr-auth)

15466 (TT-74-50011, pp 146-153) COMPARISON OF THE CHARACTERISTICS OF HYGROSCOPIC AND NONHYGROSCOPIC AEROSOL WASHOUT BY CLOUD-BORNE DROPS. Burtsev, I. I.; Burtseva, L. V. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Washout by cloud-borne drops of aerosol of size 0.1-0.5 μ is examined as a function of its hygroscopicity. Radioactive hygroscopic $^{32}P_2O_5$ and nonhygroscopic $^{89}SrCO_3$ aerosols were investigated and their washout characteristics compared. It is shown on the basis of an experimental comparison of the characteristics of the capture of aerosol of the same disperse group, but with different physical properties, that the hygroscopicity of the aerosol substantially affects its behavior in a cloud medium. The capture efficiency of hygroscopic aerosol is twice that of nonhygroscopic aerosol. (auth)

15467 (TT-74-50011, pp 166-172) UTILIZATION OF NATURAL RADIOACTIVE SUBSTANCES IN THE STUDY OF TURBULENT EXCHANGE AND ATMOSPHERIC SCAVENGING BY MEANS OF GROUND MEASUREMENTS. Bakulin, V. N.; Sen'ko, E. E.; Starikov, B. G.; Trufakin, V. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

On the basis of round-the-clock measurements of the exhalation of thoron and the concentrations of thoron and ^{212}Pb (ThB) at heights of 1 and 5 m, mean values were obtained for the growth rate of the turbulence coefficient with height in a summer anticyclone, equal to 5-10 cm/sec by day and about 3 cm/sec at night. It is shown that these data enable one to evaluate the mean value of the turbulence coefficient in the lower km layer of the troposphere with the aid of ground measurements. It is shown that, unlike thoron and ^{212}Pb(ThB), radon cannot be considered as existing in quasi-steady conditions, and we must use nonsteady models of its behavior in the atmosphere. Near the earth, the ratio between the decay products of radon is a good indicator of the time variation in the turbulent exchange. Maximum perturbations of equilibrium in the radon series are observed in the morning and evening, during the establishment and destruction of the night inversions. It is noteworthy that in the morning hours one can observe many specific features in the height distribution of radioactive substances, explained by the mechanisms of the inversion destruction process. Data are given about the washout coefficients of radioactive aerosols by precipitation on the basis of ^{212}Pb-(ThB), radon and ^{210}Pb(RaD) concentration measurements. (auth)

15468 EFFECT OF PROGRESSIVE ETCHING ON FISSION TRACK AGES. Reimer, G. M. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 87(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15469 APPLICATIONS OF RADIOECOLOGICAL TECHNIQUES TO NON-RADIOACTIVE POLLUTION STUDIES. Application to a Specific Case. Bovard, P. (CEN, Fontenay-aux-Roses, France). pp 123-134 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on nuclear techniques in comparative studies

of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Radioecologists are attracted by the idea of transferring the experience obtained in the nuclear sphere to the conventional sphere. After a critical examination of the similarities and differences involved, a particular case is considered in order to illustrate the potentialities and the limitations of such a transfer of technology. The case selected is that of choosing an indicator of chemical pollution of fresh water, the indicator in this case being the eel. The concepts of environmental capacity and of critical pathways, in particular, are borrowed from radiation protection and the experimental methods from radioecology. In the case in point, the eel is chosen for reasons of its biomass, its euryhaline character, and its commercial and alimentary importance. (auth)

15470 BIOACCUMULATION OF ^{14}C-DDT IN A SMALL POND. Salonen, L.; Vaajakorpi, H. A. (University of Helsinki). pp 201-211 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Carbon-14 ring-labeled DDT, together with inactive carrier-DDT, were pumped and mixed into a small polyhumus pond located in Southern Finland. At the beginning of the experiment, the DDT concentration in the pond water was 1 μg/l(litre) and ^{14}C activity 1 nCi/l. Initial samples were collected 4 h and final samples 2 months after application. During this period DDT concentrations were determined in filtered water, suspended matter, sediment, fish, newts, and certain invertebrates and plants. The ^{14}C-activities of all samples were determined utilizing liquid scintillation counting. With the exception of the filtered water, all samples were dried and prepared for counting using a combustion technique, which converted all samples into the same chemical form and gave high counting efficiencies. Results demonstrated that the DDT concentration in filtered water decreased quickly and that the uptake of DDT by suspended matter was rapid. Accumulation and elimination of DDT varied considerably in different fish tissues. The highest concentration (23.8 mg DDT/kg) was noted in the mesenteric adipose of perch (Perca fluviatilis L.) at the end of the test period; this concentration was higher than in liver (16.1 mg/kg), gills (3.7 mg/kg), or muscle (0.4 mg/kg). Accumulation in perch liver was rapid, with the maximum value being reached after only one day. DDT residues were determined in Crucian carp (Cyprinus carassius L.), the newt (Triturus vulgaris L.), bivalve mollusk (Sphaerium lacustre L.), caddisfly larvae (Phryganea sp.) and backswimmer (Notonecta glauca L.). The highest residue (3.0 mg/kg) among the invertebrates was in the bivalve mollusk (after 2 days). Among the aquatic plants examined, the bladderwort (Utricularia minor L.) yielded higher residues than the moss (Drepanocladus sp.). Residue elimination, after the attainment of the maximum concentration, was approximately exponential in some of the samples. The amounts of DDT used did not cause detectable symptoms of poisoning over the course of the test period. DDT metabolites were not studied. (auth)

15471 BEHAVIOR OF MERCURY COMPOUNDS IN SOILS: ACCUMULATION AND EVAPORATION. Poelstra, P.; Frissel, M. J.; van der Klugt, N.; Tap, W. (EURATOM, Wageningen, Netherlands). pp 281-292 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Fifteen soils, taken from The Netherlands, western Germany, France, and Italy were samples at various depths, and the mercury contents were determined. The soils differed widely in characteristics and farming practice. Included were foreland soils from the River Rhine, soils from the bulb-culture area, and permanent pastures. The levels in the permanent pastures varied from 0.10 ppM at the top to 0.01 ppM at a depth of 100 cm. The soils from the bulb-culture area, which have been treated with mercury-containing fungicides for many years, contained about 0.15 ppM mercury, indicating that neither leaching, nor volatilization of mercury played a significant role. Much higher levels were found in the foreland soils from the Rhine, up to 12 ppM. Indications of strong mercury adsorption in these soils were found. Leaching experiments were carried out in the laboratory on undisturbed soil columns. Experiments with ^{203}Hg-labeled dimethyl mercury, methyl mercury chloride, mercury chloride, and metallic mercury indicated that volatilization from the soil was rapid for dimethyl mercury but slow for the other compounds. Leaching hardly occurred. A mathematical simulation model was developed to explain the mercury contamination of the pastures. The model calculates the contribution due to combustion of oil and coal, to the production of mercury from ores and to natural degassing. The contribution of man-made mercury is unevenly distributed over the world's surface, so that a regional factor is included. (auth)

15472 FATE OF SELENIUM ADDED TO AGRICULTURE CROPS. Gissel-Nielsen, G. (Danish Atomic Energy Commission, Roskilde). pp 333-339 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

In many areas fodder crops contain too little selenium to meet the requirements of livestock (>0.05 ppM Se in dry fodder), and serious deficiency problems may arise (white muscle disease, etc.). Such problems can be solved by mixing selenium into the fertilizers in order to raise the selenium content of the plants. Several experiments have shown that addition of 70 to 120 g selenium per hectare as selenite is sufficient on most low-selenium soils. However, only about 1% of this selenite is utilized by the plants in the first year, so the question arises if the residue constitutes a hazard to the environment. To elucidate this, experiments have been carried out to investigate the fate of added selenium. Leaching of selenium through the soil has been subject to laboratory and field experiments, and it seems that only very small amounts of selenium disappear by leaching, hardly more than is added by the selenium content of rainwater. The biological half-life of selenium in terrestrial animals and freshwater organisms has been determined, as well as the distribution of added selenium between the organisms of biotopes. The preliminary results indicate no risk of accumulation of the added selenium in any part of the food-chain. It has also been shown that spraying selenium onto young plants has the advantage over using it in fertilizer that it requires a much smaller quantity of selenium — though the effectiveness is only short term. (auth)

15473 FATE OF A UREA HERBICIDE IN THE SOIL AND IN THE PLANTS. Suess, A.; Eben, C.; Siegmund, H.; Pater, T. (Bavarian State Inst. for Soil and Plant Cultivation, Munich). pp 373-384 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The adsorption capacity in three different soil types was studied with ^{14}C-labelled monolinuron. In a 5 ppM solution (5 g soil, 200% of maximum water capacity) 60 to 90% of the monolinuron was strongly adsorbed to the soil complex. Humic substances and clay minerals are responsible for adsorption. Because of the relatively high amounts in typical soils, most of the monolinuron is adsorbed to inorganic material. During degradation studies, soil-adsorbed monolinuron was degraded faster during the first 10 weeks than the non-adsorbed molecule. This could depend on charge transfer or inactivation of side chains or toxic metabolites. Monolinuron is decomposed by cleaving the amide linkage forming 4-chloroaniline, N, O-dimethylhydroxylamine and CO_2. The enzyme system (arylacylamidase) responsible was found in Bacillus sphaericus isolated from soil. 4-chloroaniline, a monolinuron metabolite, is also degraded in soil but at a lower rate than monolinuron. This indicates that the phenyl ring is cleaved and 4-chloroaniline is accumulated in the soil. Oats and rape plants take up adsorbed monolinuron through the roots. Soil-adsorbed monolinuron was less available to plants than a non-adsorbed one. In climatic chamber experiments, about 15% of the strongly-adsorbed monolinuron was taken up by plants in three growing seasons, each of three weeks. Amounts ranging from 15 to 60 μg of adsorbed monolinuron per 100 g soil do not influence plant yield. More than 50% of the ^{14}C-activity in the plants could not be extracted by acetone. The availability to plants of clay-adsorbed monolinuron is extremely low, while there is no significant difference between humus-adsorbed and soil-adsorbed monolinuron. Monolinuron adsorbed to filtering ash was not desorbed at all and hence was not available to plants or microorganisms. 4-chloroaniline, a metabolite of monolinuron, and 3,4-dichloroaniline, a metabolite of linuron, are also strongly adsorbed onto the soil complex. Both metabolites, 4-chloroaniline and 3,4-dichloroaniline can be absorbed by plant roots. About 5% to 7% were taken up during three growing seasons, each of three weeks. (auth)

15474 FIFTEENTH ANNUAL LOGGING SYMPOSIUM TRANSACTIONS, MC ALLEN, TEXAS, JUNE 2–5, 1974. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974). 321p. (CONF-740620-).

Twenty-eight papers were presented. A separate abstract was prepared for each of 7 papers. Twenty-one papers were on the use of well logging. (LCL)

For abstracts of individual papers see: 15475–15481.

15475 MEASUREMENT OF THE THERMAL NEUTRON ABSORPTION CROSS SECTION OF ROCK SAMPLES BY A PULSED SOURCE METHOD. Allen, L. S.; Mills, W. R. Jr. (Mobile Research and Development Corp., Dallas). pp B.1-B.9 of Fifteenth Annual Logging Symposium Transactions. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974).

From 15th annual logging symposium; McAllen, Texas, USA (2 Jun 1974). See CONF-740620-.

A pulsed neutron source technique for measuring the macroscopic thermal neutron absorption cross section, Σ_a, of common rock materials is described. The method requires only one thermal neutron lifetime determination for a mixture of crushed rock saturated with pure water. The error in determining Σ_{rock} is less than or equal to 1 c.u. (capture unit = 10^{-3} cm^{-1}). However, to reduce the effect of thermal neutron diffusion relative to absorption it is necessary to use crushed rock samples weighing approximately 15 to 20 kg. Although this limitation precludes application of the technique to small core samples, the method can be used to determine Σ_{rock} for any laboratory model whose material of construction is available. Results are given for both igneous and sedimentary rocks which outcrop in various parts of the United States. Most of the measured cross sections exceed the cross sections one would calculate for a given rock on the basis of its primary minerals. It is concluded that most of the rocks probably contain strongly absorbing trace elements such as boron or gadolinium. (auth)

15476 REVIEW OF THE USE OF LOGS TO DETERMINE ABNORMAL PRESSURES. Wichmann, P. A. (Dresser Atlas Operations, Houston, TX). pp C.1-C.16 of Fifteenth Annual Logging Symposium Transactions. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974).

From 15th annual logging symposium; McAllen, Texas, USA (2 Jun 1974). See CONF-740620-.

The theory and use of resistivity and acoustic data to determine overpressures, i.e., surpressures, geopressures, or abnormally high pressures, from the observed anomalies in the water content of shales are discussed and compared with logging methods using gamma detection and neutron logging. It is concluded that surpressures can be fairly accurately determined, particularly in Tertiary sediments, by resistivity (or conductivity) and acoustic measurements. With care, they can also be determined in older sediments although other factors can perturb the accuracy of these approaches. Other logging instruments have been used with varying degrees of success in surpressure determinations. The Densilog can do a creditable job, although its accuracy is not as reliable for this type of measurement. The Neutron Lifetime Log offers some unique possibilities for monitoring surpressure depletion while other advances in nuclear logging make the newer neutron logs distinct possibilities in these studies. (LCL)

15477 FIELD EXPERIENCE IN DETERMINING OIL SATURATIONS FROM CONTINUOUS C/O AND Ca/Si LOGS INDEPENDENT OF SALINITY AND SHALINESS. Smith, H. D. Jr.; Schultz, W. E. (Texaco, Inc., Bellaire, TX). pp K.1-K.19 of Fifteenth Annual Logging Symposium Transactions. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974).

From 15th annual logging symposium; McAllen, Texas, USA (2 Jun 1974). See CONF-740620-.

A carbon/oxygen well logging system, capable of both 5 ft/min continuous logs and also stationary measurements, has been developed at the Texaco Bellaire Research Laboratory. The technique utilizes a pulsed 14 MeV neutron source and a gamma ray detector, both similar to those employed in thermal neutron die-away logs, although operating at much higher neutron burst repetition rates and employing different detector time gates and energy ranges. Gamma rays from neutron inelastic interactions with carbon, oxygen, calcium, and silicon are developed into C/O and Ca/Si ratios which are employed to determine oil saturation and lithology, both independent of formation water salinity and shaliness. The system has been run in 77 cased field wells, and has also been extensively studied in laboratory test formations. The effects of variations in borehole parameters, such as cement thickness, fluid type, and mud type have been investigated, as have the effects of variations in formation parameters, including shaliness, porosity, water salinity, and lime content. Oil zones have been identified in both clean and shaly intervals with water salinities ranging from less than 1000 to over 125,000 ppM NaCl. In 25 of 34 conclusive perforation tests, the type of fluid production has been consistent with predictions made from C/O log derived oil saturation values. (auth)

15478 GAMMA-RAY LOG RESPONSE OF SHALY SANDSTONES. Heslop, A. (Imperial Oil Ltd., Calgary, Alberta). pp M.1-M.11 of Fifteenth Annual Logging Symposium Transactions. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974).

From 15th annual logging symposium; McAllen, Texas, USA (2 Jun 1974). See CONF-740620-.

Careful examination of several cross-plots has revealed error in the "Classical" method of calculating shale volume from the gamma log. Interpretation graphs available in the literature give misleading results. This is partly due to a general misunderstanding of the term "Shale." A new method of calculating shale volume from the gamma log is proposed. This method agrees well with data from the neutron/density cross-plot. (auth)

15479 DIGITAL LOG ANALYSIS: RECOGNITION AND TREATMENT OF FIELD RECORDING ERRORS. Connolly, E. T. (Imperial Oil Ltd., Calgary, Alberta). pp S.1-S.45 of Fifteenth Annual Logging Symposium Transactions. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974).

From 15th annual logging symposium; McAllen, Texas, USA (2 Jun 1974). See CONF-740620-.

With the trend today toward the running of compensated logging devices in the well bore, more potential sources of error are possible with these logs and recognition of "bad logs" is sometimes difficult. Density logs, having two detectors, sometimes have failures of the long or short space detector. When this occurs, the recording values of bulk density are in error and corrections should be made. Using Time Share log analysis and cross-plotting techniques, one can identify the source of error, correct for its effect and derive an edited log with a correct bulk density recording. Examples are given from four wells to demonstrate this approach. The Caliper and Gamma Ray curves on logging devices have had very little attention paid to them in the past. The Caliper was used merely as an indication of borehole rugosity, and the Gamma merely as a shale-nonshale indicator. The effects of hole size on the Gamma Ray and the effects of Gamma Ray interpretation on porosity are discussed along with the effects of out-of-round or "pear shaped" boreholes. With the advent of more and more digital wellsite recording of the logging parameters, errors are also occurring on the digital field tapes. As well, the taped data sometimes indicate otherwise unknown errors on optical analog records. Several examples of both types of error are presented and methods of interpreting taping problems and correcting for these errors are shown. With the increasing use of digital field recording by industry and the greater use of compensated downhole recording devices, the service industry must provide better methods of field quality control in digital recording along with more reliable field tool checks and calibrations. (auth)

15480 ANOMALIES OBSERVED ON WELL LOGS. Hammack, G. W. (Continental Oil Co., Houston, TX); Fertl, W. H. pp V.1-V.22 of Fifteenth Annual Logging Symposium Transactions. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974).

From 15th annual logging symposium; McAllen, Texas, USA (2 Jun 1974). See CONF-740620-.

Since the first electric log run in 1927, thousands of well logs have since been produced which aid in a realistic evaluation of subsurface formations. However, many of these logs have been misinterpreted because of either some natural occurring phenomena or erroneous log measurements going undetected. Even with today's advanced interpretation techniques combined with the most sophisticated computer log analysis many of these anomalous logs are still overlooked. The experienced log analyst can help in avoiding costly and erroneous decisions by recognizing these anomalies. (auth)

15481 DEPTH OF INVESTIGATION OF THE NEUTRON LIFETIME LOG. Hopkinson, E. C.; Youmans, A. H.; Johnson, R. B. Jr. (Dresser Atlas, Houston, TX). pp AA.1-AA.10 of Fifteenth Annual Logging Symposium Transactions. Houston, TX; Society of Professional Well Log Analysts, Inc. (1974).

From 15th annual logging symposium; McAllen, Texas, USA (2 Jun 1974). See CONF-740620-.

A novel method of experimentally deriving the geometric response characteristics of the Neutron Lifetime Log (NLL) is described. A steel tank was filled with sand which was saturated with a fixed amount of fresh water. The porosity of the wet sand was determined to be 36%. In order to determine the spatial distribution of the neutron population, small diameter aluminum probe tubes were inserted into the sand and a ^3H proportional counter was moved along each tube while a NLL was operating in the borehole. To determine the transmission-detection efficiency of the system for capture rays, a 100 mCi source of 2.6 MeV gamma rays (^{228}Th) was passed through the probe tubes and the counting rate of the detector was recorded for each source

position. A mathematical model was developed from these data and computer calculations were performed to determine the geometric response of the NLL. It is cautioned that the results apply only to the NLL instrument and only to the media porosity and water conditions used in the experiment. The vertical and radial response curves are presented. (LCL)

15482 ACTUAL AND POTENTIAL USES OF ISOTOPES AND RADIATION TECHNIQUES IN FOREST WATER RELATIONS RESEARCH. Leyton, L. (Oxford Univ.). pp 3-10 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Applications are reviewed in relation to forest influences, mainly forest hydrology and soil conservation, and water as a factor influencing tree growth. Neutron scattering techniques have in general confirmed a greater soil moisture depletion under forest than under grass. Tritiated water has been used successfully for following soil moisture depletion at different depths, and related rooting patterns have been established by placement experiments using ^{32}P-labelled phosphate and ^{131}I. Several attempts have been made to determine transpiration of trees from the rate of movement of isotopes, in particular ^{32}P, up the stems. A more promising method, which also allows for estimates of stand biomass, is based on the distribution of tritium injected into the stems. Tritium and chelated complexes of isotopes offer distinct advantages over dyes for tracing water movement in soils. Neutron and gamma absorption techniques have been used to measure snow pack density, and are potentially applicable to the determination of precipitation interception by tree crowns. Several radioisotope tracing techniques have been used to follow the dispersion and migration of mineral particles, of potential importance in the quantitative measurement of negative effects on soil conservation. Other applications relevant to forestry range from the release and circulation of nutrients from litter to the absorption and transfer of atmospheric water vapour by desert plants. Several physiological processes affecting forest growth are influenced by moisture stress and are readily demonstrated using isotopes, e.g., the assimilation of $^{14}CO_2$, the translocation of ^{14}C-labelled compounds and their incorporation into woody and other tissues. Direct measurements of the water content and distribution in tree stems, as also wood density, have been made using gamma absorption, and of the water content of leaves by beta absorption. (auth)

15483 USE OF THE GAMMA DENSITY GAUGE IN COMBINATION WITH THE NEUTRON MOISTURE PROBE. Christensen, E. R. (Technical Univ. of Denmark, Lyngby). pp 27-44 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The subsurface gamma density gauge is studied by means of a one-dimensional, spherical Monte Carlo model. Special attention is paid to the influence of Z_{eq}, Z/A, and a finite volume of the measured medium on the gauge response. Because of the larger Z/A-value of H_2O compared with that of common soil constituents, no single calibration curve exists, even if the influence of Z_{eq} is negligible. A combined density/moisture determination is performed as follows. A first estimate ρ'_w of the wet density is obtained by the density gauge from the Z/A = 0.499 curve. Next, the correct vol. % H_2O, V is determined, with ρ'_w as a parameter, by the neutron moisture probe. Finally, the correct wet density ρ_w is calculated as $\rho_w = \rho'_w - 0.114 \times V$. If these corrections are not applied, systematic errors of about $\Delta\rho_w = 0.04$ g/cm^3 and $\Delta V = 0.8$ vol. % H_2O at $\rho_w = 2$ g/cm^3 and V = 36 vol. % H_2O will be introduced. For densities above 1 g/cm^3, the radius of the sphere of importance is about 26–40 cm and considerably larger at lower densities. At small and moderate water contents this radius is significantly smaller than published values of that of the neutron moisture gauge. Good agreement between the calculations and measurements with a commercial gauge is obtained if maximally two experimentally determined parameters are introduced. (auth)

15484 NEW EQUATION TO ESTIMATE SOIL-WATER DIFFUSIVITY. Reichardt, K.; Libardi, P. L. (Univ. of Sao Paulo, Brazil). pp 45-51 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

A new, simple equation is described to estimate soil-water diffusivity based on experiments of horizontal infiltration of water into an air-dried soil. A horizontal infiltration run has to be made for the given soil, whereby the distance to the wetting front is plotted as a function of the square root of time. A factor equal to the square of the ratio between the slope of this plot for the given soil and a standard soil permits the soil-water diffusivity to be estimated by applying a simple equation. The method has been established theoretically and experimentally using five Brazilian tropical soils and eight Californian temperate soils, of which one was arbitrarily taken as a standard. Bulk density measurements to test homogeneities of the soil columns and volumetric water content measurements have been made by the gamma attenuation technique, using ^{137}Cs gamma radiation. (auth)

15485 METHOD OF CALIBRATING A NEUTRON SOIL-MOISTURE GAUGE ON THE BASIS OF DENSITY MEASUREMENTS FROM AN ASSOCIATED GAMMA DENSITY GAUGE. Normand, M. (Centre Technique de Genie Rural, Atony, France). pp 53-69 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Despite all the methods that have been proposed, calibration of a neutron moisture meter is still the principal problem encountered by anyone using this type of instrument for different types of soil. The manufacturer generally supplies a curve or rather a set of curves which can be used for taking the effect of density into account and which represents the calibration for a standard of soil. This primary calibration usually has to be corrected when a new soil is investigated. A method is proposed consisting first of all in deriving semi-empirically a number of sets of calibration curves from the basic set. After installation of an access tube, the moisture profile by weight is determined by the gravimetric method on samples taken from the site of the tube. Then, by carrying out immediate measurements with a neutron moisture gauge coupled to a gamma-ray density gauge, one can determine as many water profiles (moisture content by volume and moisture content by weight) as there are sets of calibration curves. Comparison of the water profiles (moisture content by weight) obtained by the two methods indicates which set of curves is most suitable for the type of soil under investigation. The work is facilitated by using a computer program, which supplies for each set of curves and each measuring point the wet density, the moisture content by volume, the moisture content by weight and the dry density, and draws the corresponding profiles as well as the water profile obtained with the samples. A description is given of the application of this method for studying the moisture content of the soil on a drained plot at the station of Boissy-le-Châtel in the Orgeval basin (Seine-et-Marne). Various checks were made, particularly in regard to the validity of the wet density calibration curve (undisturbed samples) and possible changes in the calibration during the first months after installation of the tubes. The results obtained show the advantages and disadvantages of the method. (auth)

15486 STUDY OF THE SCATTER OF NEUTRON MEASUREMENT DATA: APPLICATION TO THE MEASUREMENT OF VARIATION IN SOIL MOISTURE STORAGE FOR TWO DIFFERENT GRAMINEOUS CROPS. Cardon, D. (Office de la Recherche Scientific et Technique Outre-mer, Paris). pp 71-83 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

At a given level in a given soil, neutron measurements show considerable scatter. This is due to the non-uniformity of the soil in situ and to the small volume explored by the probe during each measurement. To determine with the required accuracy the minimum number of measurements that need to be made in order to establish the variation in the moisture reserve of a given horizon, a statistical study was carried out of the variation in the measurements for three different levels. For this purpose four horizontal tubes 2.5 m long permitting 40 almost independent measurements were implanted per level studied. Each time the measurements were repeated at the same places. It was found that under these conditions it was necessary to make at least 70 independent measurements in order to evaluate the variation in the soil moisture reserve over a thickness of 2 m with a precision better than 5 mm; moreover, this did not take into account inaccuracies due to calibration and to the number of measurement levels that was of necessity restricted. The number of levels would be still greater

if it were required to ascertain the soil moisture reserve in absolute terms. On the other hand, since the instrument error proved smaller than the soil error, it is possible to decrease the measurement time from 100 to 20 s without any trouble. Applying the previous results, two measuring posts were set up in Panicum maximum and Paspalum notatum cultures, which were kept near to the true maximum evapo-transpiration; these posts were used to measure the variation in moisture reserve within the first two metres of soil. For each of the posts 13 horizontal tubes were implanted at eight different levels. The other terms in the water balance for the two crops were also measured, so that from knowledge of the variation in the soil moisture reserve the true maximum evapotranspiration was able to be derived. In both cases the results obtained were in agreement with the data obtained from a weighable evapotranspirometer, thus confirming the validity of the statistical study and the concept of climatic evapotranspiration. (auth)

15487 MOVEMENT OF WATER VAPOR IN ARID LOESS SOIL UNDER CONDITIONS OF TEMPERATURE INVERSIONS. Bunnenberg, C.; Kuehn, W. (Institut fuer Strahlenbotanik, Hanover). pp 89-95 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Daily temperature inversions occurring in the superficial soil layers are of special interest in climates with small amounts of rain and large temperature variations. The temperature gradients cause transport of water vapour into deeper soil layers during the day, which may result in condensation at plant root level, and in the opposite direction at night. Because of the large temperature drop from day to night there is also a distinct possibility that dew may form and penetrate into the soil. These phenomena have to be taken into consideration when studying the water budget in soils of arid regions. Laboratory experiments were carried out to investigate the evaporation from arid loess soil under the condition of a constant temperature gradient, and to study the penetration of water vapour into the soil under the condition of temperature inversions in a 24-h cycle. The tritium-labelled vapour could be measured directly and continuously by a flow-through type proportional counter. (auth)

15488 REGIONAL STUDY ON DEEP PERCOLATION AND MOVEMENT OF GROUND WATER IN TUNISIA AND SOME OASES OF ALGERIA. Scharpenseel, H. W. (Univ., Bonn); Ohling, J. pp 97-116 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

In arid zone agriculture systems as divergent as nomadism and field irrigation coexist and compete because of the shortage of water. Considerable subterranean water reserves, phreatic or fossilized, occur in some regions, such as in most of the semi-arid and arid lands of N. Africa. They severely limit the potential development of the land through up-to-date technology. Usually these water resources of the arid zones stem from past precipitations in adjacent or remote recharge areas. Under favourable conditions, such as in Tunisia, with complete existing records of depth, geologic formation, texture of aquifer material, analysis and conductivity of the pumped or artesian water, deep percolation, water movement and recharge mechanism can often be reconstructed from natural ^{14}C- and ^{3}H-measurements in water samples. Such information is valuable for water inventory and availability estimates in connection with agricultural landscape and project planning. Data were collected from 166 wells and bore holes throughout Tunisia as well as in some oases of Algeria, particularly in the plain of Kairouan and the central region of the Chotts. Their evaluation and preliminary interpretation in connection with lateral and vertical movement, flow speed and isochrones of main aquifers is presented. (auth)

15489 SOIL-WATER AND SOLUTE MOVEMENT STUDIES. Nielsen, D. R.; Starr, J. L.; Kirda, C.; Misra, C. (Univ. of California, Davis). pp 117-133 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The simultaneous transport of water and solutes through soil profiles is examined theoretically and experimentally with the aid of isotopic tracers for selected conditions in the absence of plants. Methodology is presented for treating the movement of water and solutes by integrating the combined effects of the appropriate physical, chemical and microbiological processes. Steady-state leaching in the presence of soil nitrogen transformations, sampling the soil solution, and leaching during infiltration and redistribution are examined in detail. (auth)

15490 TRITIUM AND OXYGEN-18 LABELLING AS APPLIED TO THE STUDY OF SATURATED AND NON-SATURATED SOIL DISPERSION EFFECTS. Ramodiharilafy, J.; Couchat, Ph. (CEA, Saint-Paul-lez-Durance, France). pp 135-144 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The movement of water in saturated and non-saturated soils is the result of two phenomena: a mass movement described by the generalized Darcy equation/continuity equation system, and dispersion as reflected by the dispersion equation with a convective term. Whereas the former component of the movement can be ascertained experimentally by simultaneous measurement of the water content (neutron moisture gauges) and potential (tensiometers recording up to 800 mbar), this is not the case with the latter, which can only be found by using a suitable label for the moisture. In the case of saturated soils, tests on the displacement of miscible liquids (water/tritiated water) in columns provide us, on the basis of analysis of the mixing curves, with the dispersion coefficients. By using the Saffman representation we can describe agricultural soils from the standpoint of dispersion, irrespective of the experimental conditions. A mathematical model representing the dispersion equation permits extrapolation of the experimental data to other geometric parameters and boundary conditions. In this case, labelling the water with tritium is in itself enough for developing and adjusting the mathematical model; the dispersion coefficient used involves a diffusion term suitable for the tritiated water in saturated soils, and also a velocity term. In non-saturated soils a double tracer experiment using tritium and ^{18}O enabled the similarity between dispersion effects in saturated and non-saturated media to be predicted; the substitution of tritium-labelled water for ^{18}O-labelled water under non-saturation conditions was studied; analysis of the mixing curves obtained for two opposite initial distributions of the water content showed that the displacement of non-saturating water present in the soil follows a mechanism similar to the one established for a saturated medium; the concept of a dispersion coefficient can be generalized by defining it as a function of the moisture content. When linked with the mass movement, the generalized dispersion model should be of use in determining the true movement of rain water or irrigation water in non-saturated soils. (auth)

15491 TRACING SOIL MOISTURE MIGRATION WITH ^{36}Cl, ^{60}Co AND TRITIUM. Frissel, M. J. (EURATOM, Wageningen, Netherlands); Poelstra, P.; Harmsen, K.; Bolt, G. H. pp 145-148 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

In a study on dispersion effects in soils the migration of water was traced by the simultaneous addition of three radioactive tracers; ^{3}H to label water molecules, ^{36}Cl to label chloride anions and ^{60}Co to label cobalt cyanide anions. The studies were performed on undisturbed soil columns (100 cm length, 12 cm diameter). From the observed breakthrough curves and theoretical curves (calculated with simulation models) it appeared that for clay and sand, adsorption of tritium was negligible, the use of anions would lead to errors of 11% for sand and 37% for clay due to anion exclusion. The dispersion distance appeared to be independent of the type of label. (auth)

15492 MODELING OF SALT MOVEMENT IN SOILS. Laudelout, H. (Catholic Univ. of Louvain, Heverlee, Belgium). pp 153-157 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

It is shown that models for salt movement based on a salt conservation equation can be related to a finite difference formulation

of the partial differential equation describing salt movement through the soil. The usefulness of the salt conservation models is determined by the knowledge of the dispersivity coefficient, which determines the number of layers used for calculation of salt movement and by the pore volume of the soil profile. (auth)

15493 MOVEMENT OF SULFATE ION THROUGH SOILS. Ahmed, M. I.; Reddy, S.; Subbiah, B. V.; Dakshinamurti, C. (Indian Agriculture Research Inst., New Delhi). pp 159-178 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Field experiments conducted for maximization of yields with a given unit of water indicated that quantities of water required to bring the rhizosphere to field capacity level or ¾ of that value would work out as optimum irrigation levels. In these irrigations with restricted quantities of water where the soil moisture was brought to ½ bar suction pressure, loss of the plant nutrient nitrogen into the sub-soil worked out to be minimum. With a view to understand the movement of another soluble nutrient, sulphate ion, laboratory experiments for the upward, downward and lateral migration of the sulphate ion were planned with red and alluvial soils using ^{35}S as tracer. With a level of irrigation equivalent to a moisture content of ½ bar in the soil column, the sulphate ion was found to remain just within the soil zone without getting leached even with suction pressures of the order of 21.0 cm of mercury applied. For higher values of irrigation water applied, most of the sulphate ion leached. Surface evaporation studies indicated that the amount of ion that moved upward from the zone of placement of active material worked out as 0.42 of the water loss from that zone. The nutrient movement thus appears to lag behind the water movement. Lateral migration of tagged sulphate ion due to root suction was found to be restricted in red soils compared with that in the alluvial soils. The distinct differences observed in the quantity of sulphate ion migrated from the zone of placement in both the soils were explained as caused by interactions between (i) the sulphate ion and the clay types present and (ii) the sulphate ion and the sesquioxides of the soil. (auth)

15494 MOVEMENT OF POLYPHOSPHATE FERTILIZERS AND RADIOSTRONTIUM IN CONTRASTING INDIAN SOIL TYPES. Mistry, K. B.; Yadav, V. B.; Bhujbal, B. M. (Bhabha Atomic Research Centre, Bombay). pp 179-193 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Tri- and tetra-ammonium pyrophosphates are the principal constituents of the recently developed ammonium polyphosphate fertilizers. Movement of the pyrophosphates, relative to that of ammonium orthophosphate, in columns of typical red, laterite and black soils of India was examined under conditions of continuous replenishment of moisture approximating those prevailing under assured irrigation as well as under conditions where diffusion was the predominant mode of ion transport. The soils covered a wide range of pH (5.2-8.9) and other physicochemical characteristics. ^{32}P-labelled compounds were used in the experiments which extended up to eight weeks. Under conditions of continuous replenishment of moisture in the laterite and medium and deep black soils, the pyrophosphates as well as the orthophosphate were totally immobilized in the soil layer to which they were applied. In the red loam about 10% of the orthophosphate and 5-8% of the pyrophosphates were transported away from the site of application. Under diffusion conditions, no detectable quantities of either the pyrophosphates or the orthophosphate moved out of the fertilized layer in all soils examined. The significance of these results is discussed in relation to the adsorption maxima of polyphosphates in soils, their hydrolysis to orthophosphate and their relative efficiency as sources of phosphorus for plants. Studies were also undertaken on the influence of varying amounts of simulated rain, irrigation waters and a chelating agent on the leaching of radiostrontium, a long-lived fission product radionuclide of biological significance, through laterite and black soils. Results indicated that leaching with the chelate solution produced the greatest movement of radiostrontium in soils. Considerably greater downward movement of the radionuclide was observed with moderately high calcium irrigation water compared with that involving either moderately high sodium irrigation water or de-ionized water. In general, radiostrontium was more mobile in the laterite than in the black soil. (auth)

15495 USE OF RADIOISOTOPES TO DETERMINE SURFACE MOVEMENT OF PHOSPHORUS FERTILIZER ON SLOPING LAND. Ketcheson, J. W.; Onderdonk, J. J. (Univ. of Guelph, Ontario, Canada). pp 195-201 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Phosphorus in surface water is undesirable where it contributes to the abnormal growth of organisms such as algae. As phosphorus, because of its immobility, is not likely to be carried by ground water from mineral soils, surface movement is of more concern. The chief carrier is the sediment that may be eroded and to which the phosphorus tends to be adsorbed. Although sediment and phosphorus may erode from a certain slope, it is largely dependent on a suitable transport system to move it to a surface body of water before problems arise. ^{32}P-labelled fertilizer was used in a field study as a convenient means of following the movement of a fertilizer source of phosphorus. By including different lengths and degrees of slope it was possible to determine the rate and manner in which the phosphorus disappeared from the initial run-off material. (auth)

15496 SOIL-WATER PROPERTIES OF A LAYERED SOIL DETERMINED IN SITU. Poulovassilis, A. (Agricultural Research Council, Cambridge, Eng.); Krentos, V. D.; Stylianou, Y.; Metochis, Ch. pp 205-224 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Two methods, complementing each other, are described for in situ measurement of the soil-water properties of a layered soil profile. The first method consists in developing steady-state suction and moisture profiles in the soil by applying constant infiltration rates at its surface. The theory describing the general shape of the steady-state profile in a soil layer sequence is briefly presented. The second method consists in recording moisture changes and suction gradients in a draining layered soil profile which can be used for calculating hydraulic conductivities. The general shape of the transient profiles in a layered soil is briefly examined, and it is pointed out that during such a transient flow in layered soils it is possible to determine the moisture characteristics of some of the layers. The experimental results obtained in a layered soil in a small valley near Nicosia, Cyprus, include steady-state suction and moisture profiles; from these profiles moisture characteristics and hydraulic conductivities at high moisture contents were determined by correlating moisture contents (assessed throughout this work by a neutron moisture gauge) and suctions of the uniform zones of the profiles at constant flow rates sustaining the latter. They also include transient suction profiles and changes in the soil moisture with time of the various layers; from these, moisture characteristics and conductivities of the layers at low moisture contents were determined. The moisture characteristics and relationships of the hydraulic conductivity with moisture content and suction thus obtained are presented and discussed. (auth)

15497 SIMULTANEOUS USE OF NEUTRON MOISTURE GAUGES AND GAMMA EMITTERS FOR IN SITU MEASUREMENTS OF WATER AND ION MOVEMENT IN NON-SATURATED SOILS. Rancon, D. (CEA, Saint-Paul-lez-Durance, France). pp 225-249 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The neutron technique for determining moisture profiles and delimiting soil moisture volumes has been combined with the technique of radioactive tracer detection based on gamma radiation. In this way it has been possible to measure the relative rates of movement of water and ions in soils, together with the dispersion of the tracers due to leaching by water and the effect of the chemical composition of the effluent on ion dispersion. The tracer technique can also be used to follow the progress in the soil of compounds present in weighable concentrations; in this way it was possible to establish more accurately the great difference in behaviour between tracers and carriers. The experiments were carried out with tracers differing very considerably in properties and behavior: ^{131}I was used to simulate ions poorly

retained by the minerals, and ^{85}Sr was employed for those strongly retained by them. These methods are especially applicable to in situ analyses of ion movement and to study of the pollution of underground media. (auth)

15498 AUTOMATIC IN SITU CHECKING OF WATER TRANSFER IN THE UNSATURATED ZONE. Vachaud, G.; Tehel, J.; Royer, J. M.; Bolcato, R. (Univ., Grenoble, France). pp 251-270 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Checking the dynamics of water movement in the unsaturated zone is one of the prime objectives of hydrological and agronomic research, since it is a means of determining the variations in soil water content and characterizing directly the hydrodynamic properties of the soil (capillary pressure and hydraulic conductivity), which are necessary for developing a numerical model of water transfers. Such checking is possible, however, only if simultaneous, independent and continuous measurements are made of the variations in water content and pressures in the surface zone. A measurement method is described based on a combination of tensiometers and pressure sensors connected to a scanning and magnetic recording system and on a neutron probe (also with magnetic recording), the movements of which are automatic and programmable. Both these instrument set-ups are completely self-contained and automatic in operation. By adapting the measuring programs to the meteorological conditions, it is equally possible to follow the fast dynamics of infiltration and the slow dynamics of redistribution occurring with evaporation and drainage. After presenting results for a relatively short but intense measurement period (the high measurement frequency enabling one to define the physics of the transfers), the advantages of the method are emphasized, evaporation values measured in a catchment area over a period of nine months being compared with values estimated by means of classical methods. (auth)

15499 EXPERIMENTAL COMPARISON OF INFILTRATION AND DRAINAGE METHODS FOR DETERMINING UNSATURATED HYDRAULIC CONDUCTIVITY OF A SOIL PROFILE IN SITU. Hillel, D.; Benyamini, Y. (Hebrew Univ., Rehovot, Israel). pp 271-275 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The functional relation of hydraulic conductivity to soil wetness and suction was studied by means of alternative methods. These included in situ measurements based on a variable-intensity rainfall simulator and internal drainage of a covered soil. A radiation technique was used in monitoring soil moisture. The results indicate the feasibility of using in situ methods and their practical applications in the field. The two methods gave mutually consistent results. (auth)

15500 HYDRODYNAMIC SOIL STUDIES INVOLVING THE USE OF AN AUTOMATIC NEUTRON MOISTURE GAUGE. Marcesse, J.; Couchat, Ph. (CEA, Saint-Paul-lez-Durance, France). pp 277-293 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Any study of the soil of a given region for purposes of irrigation should include a section on the hydrodynamic behavior of the different types of soil present. These analyses are usually made in the laboratory with samples that have been altered by treatment, without regard to the structural context. The hydropedological propection method proposed consists in supplying a constant head of water at each selected site, within a double ring 2.5 m in outer diameter and extending 5 cm deep into the soil, and recording the neutron profiles during the infiltration and drying stages. The neutron moisture gauge (NEMO 10) used for studies of this kind is a very recent development. It is portable and operates entirely automatically and independently in the field; it consists of a mechanical part with a hoisting device for movement of the probe, and an electronic part, which is programmed and fitted with a clock. The data are recorded on cassette-type magnetic tape and processed by computer. In the case of the muddy-sandy soil at Cadarache, from an analysis of profiles recorded at successive time intervals the rate of advancement of the wetting front, the saturation capacity of the soil, and data on the fast and slow kinetic processes involved in drying were determined from which the soil moisture retention can then be derived. The variations in macroporosity along the profile are revealed, whereas simultaneous tensiometric readings enable one to calculate the in situ values of the conductivity parameters. Equipped with these hydrodynamic data, the agronomist can determine to what extent the soils within the area to be cultivated can be irrigated, and to foresee the amount of irrigation required. (auth)

15501 MEASUREMENT OF SURFACE WATER STORAGE ON RYEGRASS AND CLOVER BY NUCLEAR METHODS. Reiniger, P.; Levi, E.; Coppola, M. (Joint Research Centre, Ispra, Italy). pp 327-334 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

An accurate knowledge of surface storage of water on vegetation is of importance in determining the water balance of land surfaces and the foliar retention of pollutants and nutrient elements present in rain or irrigation water. An attempt was made to determine under greenhouse conditions the surface water storage on ryegrass, clover, and a mixture of both plants grown in soil. The method adopted was that of applying an artificial rain of various intensities, measuring the total water received by plants plus soil by weighing and determining the fraction reaching the soil by gamma attenuation. Precautions were taken to ensure the accuracy of these determinations under widely fluctuating temperatures. Results obtained by this method were compared with those calculated from the retention of radioactive tracers by the parts of the plants above ground. (auth)

15502 NEUTRON MOISTURE METER AND BETA-GAUGING TECHNIQUE TO INVESTIGATE PLANT-WATER RELATIONS FOR MAIZE (ZEA MAYS, L.) IN WESTERN NIGERIA. Babalola, O.; Lal, R. (International Inst. of Tropical Agriculture, Ibadan, Nigeria). pp 335-349 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The effects of five soils and three moisture regimes were studied on maize in a field lysimetric investigation. The soil treatments consisted of a sub-surface 15-cm-thick horizon of zero (B), 50 (A) and 100% (D) gravels in a clay loam matrix at 15-cm depth; and with 0% gravels but having an underlying horizon with a density of 1.4 instead of a normal density of 1.2 $g \cdot cm^{-3}$ (C). One profile was reconstituted from a uniform soil of loamy and texture (E). The soil moisture potentials of 0.3 (M_1), 2.0 (M_2) and 10.0 (M_3) bar at 30-cm depth were monitored by a neutron moisture meter and gypsum blocks. The plant moisture potential was measured by beta-gauging equipment. Plant height, dry matter production and grain yield were significantly affected by both the soils and moisture treatments. The grain yield varied between 226, 181, 177, 159 and 35 g/lysimeter for A, B, C, E and D soils respectively. Similarly, the grain yields were 329, 148 and 55 g/lysimeter for the M_1, M_2 and M_3 treatments. The water use efficiency was the lowest for soil D. The differences in leaf moisture potential at 08.00 and 15.00 hours were significant for the M_2 and M_3 treatments. At the silking stage, the average ear leaf moisture potential was 8, 10 and 12 bar for M_1, M_2 and M_3 treatments respectively. The flag leaf moisture potential, however, varied between 8 to 13, 11 to 25 and 12 to 43 bars respectively, for M_1, M_2 and M_3 treatments. The highest leaf moisture potential was recorded for soil D. (auth)

15503 WATER REQUIREMENTS OF THE MAJOR CROPS IN SENEGAL. Dancette, C. (Institut de Recherches Agronomiques, Bambey, Senegal, France). pp 351-371 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The water requirements of crops in tropical regions are becoming an increasingly important question from the point of view of adaptation to climate and of irrigation. After several years of measuring potential evapotranspiration on grass in Senegal, the next step is to measure directly the specific requirements of each crop by means of evapotranspirometers or neutron methods. The

requirements measured in this way are compared with a reference standard—the evaporation of free water in a class A pan. The Institut de Recherches Agronomiques Tropicales and the Office de mise en valeur du fleuve Sénégal (OMVS-UNDP-FAO) have already obtained some results concerning the water requirements and uptake pattern of several crops. The advantages and faults of the principal measurement techniques are discussed and an indication is given of the practical precautions which should be taken. Particular attention is paid to certain problems: the role of evaporation from the bare soil at the beginning of the crop cycle; imprecision in determining the water balance due to the soil, the kind of crop, rain, irrigation and the measurements themselves. Information is given on two types of experimental system for monitoring water uptake in the field. (auth)

15504 EXPERIMENTAL AND THEORETICAL STUDY OF THE UPTAKE OF SOIL MOISTURE BY PLANT ROOTS. Moutonnet, P.; Couchat, Ph. (CEA, Saint-Paul-lez-Durance, France). pp 373-387 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Within its environment, the plant utilizes soil moisture reserves in response to climatic evapotranspiration so as to optimize its turgidity, which is a basic factor in its growth. This process is linked with: the state of the water reserves (moisture content by volume $\theta(z)$, and capillary potential $\Psi(z)$); the hydrodynamic characteristics of the soil (conductivity K (θ), and diffusivity D (θ)); evapotranspiration; and the plant root profile, expressed in effective root density. The last-mentioned of these factors is singled out as being particularly important in a plant laboratory study on columns of soil grown with maize (Zea mays) and Italian rye grass (Lolium italicum). Having first been brought up to field capacity, the soil is allowed to dry, the profiles $\theta(z)$ being determined by automated gamma scanning. A concurrent study is made of changes in the capillary potential of the soil moisture $\Psi(z)$, using six porous filter tube/pressure detector units. At the end of the experiment the columns are discarded and the roots extracted by screening, in horizons 5-cm thick, so as to determine the root density by weight. Furthermore, the hydrodynamic characteristics of the bare soil are derived from moisture content measurements made by gamma scanning in horizontal (D (θ)) and vertical (K (θ), D (θ)) columns. The fitting of these parameters over the range employed is performed on the basis of an exponential relationship, use being made of a mathematical model for water migration in a non-saturated porous medium, written in CSMP III code. By using the measurements on plants we can determine, for each soil layer, two different water flows: the first through the soil and the second in the plant roots, which contribute in terms of their effective density. The mechanism by which the roots contribute is then studied in comparison with the CSMP III mathematical model, in which the root water flow is present as a negative source term in the diffusion equation. The problem is to account properly for this source term as a function of the effective root density and the hydrodynamic parameters of the soil. (auth)

15505 STUDIES ON WATER-USE EFFICIENCY FOR THE MAIZE CROP. Sharif, M.; Tahir, M.; Chaudhry, F. M. (Nuclear Inst. for Agriculture and Biology, Lyallpur, Pakistan). pp 389-399 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Evapotranspiration (E_t) of maize was studied under two irrigation regimes by direct weighings of the hydraulic lysimeters of $2 \times 2 \times 2$ m size, and by monitoring of soil moisture changes in soil profiles with the aid of a neutron moisture meter. The evaporation potential after Penman (E_p) was calculated from the meteorological data. The ratio of E_t/E_p was found to be low (0.4 to 0.6) at the early stages of crop growth, increased rapidly to a maximum of about 1.0 at from 30 to 40 days after planting, remained constant until crop maturity and showed a slight decrease at harvesting, indicating low water requirements of maize at the beginning and high at a later stage of the crop growth. Water-use efficiency for the grains was found to be about 120 kg per ha/cm of water. Higher applications of irrigation water were found to be economically advantageous as they led to a proportionately higher yield of grain. ^{15}N-data indicated that fertilizer uptake was higher in wet than in the dry treatment, and that more of the fertilizer nitrogen moved to the grains. Total recovery of the applied fertilizer was found to be only from 15 to 39%. (auth)

15506 GRADUAL DECREASE IN ACTUAL EVAPOTRANSPIRATION AFTER IRRIGATION OR RAINFALL. Kijne, J. W. (Agricultural Univ., Wageningen, Netherlands). pp 401-415 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

A simple model was proposed for the relationship between the ratio of actual to potential evapotranspiration and time after the soil moisture supply had been completely replenished, based on data reported in the literature. This model was checked with experimental data for several crops gathered under different environmental conditions, and compared with a more sophisticated model which requires knowledge of soil moisture characteristics which are often not available in ordinary irrigation practice. The usefulness of curves that relate the average ratio of actual to potential evapotranspiration between irrigation to time, for the calculation of irrigation schedules, i.e., frequencies and amount of application, was discussed in terms of an example from central Iraq. It was concluded that the average actual evapotranspiration rate will be significantly less than the potential rate when long intervals between irrigations are adopted. If this is not taken into consideration in the calculation of irrigation frequencies and amounts, more water may be applied than required. It is suggested that production functions should be determined in order to select a minimum value of the average E_a/E_p ratio which can be tolerated during irrigation intervals. A plea is made for the experimental determination of the relationships between E_a/E_p and moisture content and time since irrigation has taken place. (auth)

15507 SOIL CONDITIONING AND ITS EFFECT ON WATER USE. De Boodt, M.; Verplancke, H.; De Bisschop, F. (State Univ. of Ghent). pp 417-433 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

When soil conditioners are applied not only are more stable aggregates with a changed porous system obtained but also by the very nature of the products, which are always either hydrophilic or hydrophobic, the water use for plant growth can be made more efficient. From the theoretical treatment of the problem given, it becomes apparent that the soil-water capacity and the infiltration rate can be improved, erosion and run-off can be reduced, and also in the treated soil layer itself, water movement can be changed according to the nature of the conditioner. Laboratory as well as practical results are presented showing these changes. Economically justified examples are: the use of polyacrylamide (hydrophylic product) to improve water movement towards the seeds resulting in a better germination rate and a better growth of young planted trees, when the plant-pit is treated. Through the use of a hydrophobic soil conditioner, e.g., bitumen emulsion, the transpiration rate of the soil surface can be cut down by more than 50%. Important savings of water can also be achieved by lining the irrigation ditches with this product. (auth)

15508 DEPTHS OF WATER EXTRACTION BY ROOTS: APPLICATION TO SOIL-WATER BALANCE STUDIES. McGowan, M. (Nottingham Univ. School of Agriculture, Sutton Bonington, Eng.). pp 435-445 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

Information on the amounts of water draining through a soil profile is of prime importance in many studies involving soil-water measurements. An approach is described based upon determination of the effective depth of soil influenced by root water extraction. Water regimes of different soil types growing spring cereal or mixed grass sward were assessed by a neutron probe and by tensiometers. Graphs drawn of the water content against time for individual measurement depths reveal an increase in rate of water loss that can be identified with the arrival of a drying front associated with root extraction of water. By following the progress of the drying front through the soil profile the effective depth of soil contributing to the water supply of crops can be assessed. Estimates of extraction depth were found to be similar to the depths at which the gradient of hydraulic potential, indicated by tensiometers, was zero and thus the depths at which the soil water flux was also zero. For cereals during periods of uninterrupted soil drying, extraction depths also closely followed

the limit of root penetration shown by root weights in core samples. Changes in water content above and below estimated extraction depths can thus be used to distinguish the depletion of water by root extraction from that caused by prolonged drainage. This method of separation shows that drainage losses in particular may differ widely over small distances in the field, and examples highlight the importance of careful replication where it is desired to extrapolate water balances observed at individual points to larger areas. (auth)

15509 SOIL WATER RESERVES AND COMPARISON OF THEIR UTILIZATION BY TROPICAL GRAMINEOUS AND LEGUMINOUS FODDER CROPS. Talineau, J. C.; Roose, E. J. (Office de la Recherche Scientific et Technique Outre-mer, Paris). pp 447-464 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

At the ORSTOM Centre at Adiopodoumé (Lower Ivory Coast), research was carried out on the soil water characteristics and the water supply of tropical gramineous and leguminous fodder crops, notably Panicum maximum and Stylosanthes guyanensis, treated with different amounts of mineral fertilizer. The investigation of the water reserves deals with the ways by which the soil reservoir is filled up, drying phenomena, the effect of evaporation and the availability of soil water. The results show that an appreciable proportion of the total porosity is used only temporarily by the water; they also show the effect of evaporation on the depth redistribution of soil water and the appreciable differences between measurements of the capillary potential in situ and on prepared samples. The weekly water profiles of land under vegetation are analysed in relation to field capacity and minimum retention. The results indicate the existence of a depleted horizon deep down, whose water reserves are not completely utilized; they also show differences in the drying rates of the soil and the lower limit of utilization of soil water reserves according to the crop (gramineous or leguminous). (auth)

15510 WATER DISTRIBUTION IN AN ORCHARD IRRIGATED BY SPRINKLER OR TRICKLER IRRIGATION AS MEASURED BY THE NEUTRON METHOD. Dasberg, S.; Steinhardt, R. (Inst. of Soils and Water, Bet Dagan, Israel). pp 467-475 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

In deciduous orchards planted on grumosol clay in Israel, soil compaction caused by orchard traffic occurs frequently. Measurements were made of the water infiltration capacity of the soil, the water movement in the soil and the water use, as well as of plant response (tree growth and yield) under several management systems in a pear orchard. It was found that the heavy soil can take up only a limited amount of water before ponding and eventually run-off occur. The more compacted the soil, the lower this amount is. After 1 or 2 h, the infiltration capacity of the soil falls below 1 mm/h in the compacted soil regions, which is much less than the usual sprinkling irrigation intensities. Lowering the sprinkling intensity does not improve the water uptake of the soil; on the contrary, because of the prolonged irrigation time, the structure of the upper soil layer is destroyed and the infiltration capacity is lowered. Vertical mulching or the addition of a soil conditioner resulted in an increase in water infiltration during the first year, which tended to disappear in subsequent years. Measurements of the soil water content by the neutron scattering method showed that the water applied by irrigation does not penetrate to the whole depth of the root system, but that during the winter season rain does penetrate to the whole depth. During the irrigation season a gradual decrease in the soil water content of the deeper layers occurs. The pattern of the water distribution and extraction with trickle irrigation at different frequency was compared with sprinkling. Trickle irrigation resulted in deeper penetration of irrigation water than sprinkling with comparable amounts of water. With trickling, drier soil regions tended to develop between the tree rows, which decreased the likelihood of soil compaction. It was found that with trickle irrigation, the main root activity was concentrated in the area near the tree trunk. Tree growth, fruit yield and quality were higher with trickle irrigation than with sprinkling. (auth)

15511 POSSIBILITIES OF USING THE NEUTRON METHOD FOR WATER APPLICATION EFFICIENCY STUDIES IN SPRINKLER AND FURROW IRRIGATION. Paltineau, I. C. (Research Inst. for Cereals and Industrial Plants, Fundulea, Ilfov, Romania); Apostol, I. pp 477-506 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

As fresh water is in short supply throughout the world it must be economically used. If, ideally, irrigation water is run without losses to the sprinkler nozzle or to the gate of the furrow irrigation pipeline, then the principal goal of the farmer is to store the highest percentage of applied water in the root zone of the crops and uniformly throughout the field. The neutron method can be used for measuring soil moisture content and its variation during the irrigation cycle. Two Romanian neutron meters are described (a Ra-Be and an Am-Be source), made by the Atomic Physics Institute in Bucharest. The neutron meter with the Ra-Be source was used in field experiments for water application efficiency studies in sprinkler and furrow irrigation. A complete water balance is presented starting from the sprinkler nozzle and finishing in the soil, in a three-irrigation-treatment experiment on corn (38 mm, 74 mm and 108 mm of applied water). The water balance shows how much water left the sprinkler nozzle, how much water arrived at the corn crop canopy, how much water ran along the plant leaves and stem, how much water arrived at the soil surface and how much water was stored in the root zone on a silty clay loam at the Research Institute for Cereals and Industrial Plants, Fundulea, Romania. Water application efficiency, measured by the neutron method and calculated for a rooting depth of 80 cm, decreased from 76% to 53% when the depth of irrigation water applied increased from 38.4 mm to 108.4 mm. If rainfall occurs soon after irrigation water application, efficiency will decrease. Taking into consideration a depth of soil 40 cm lower or higher than the usual active root zone of corn (0 to 80 cm) water application efficiency values can be in error by neglecting the action of evapotranspiration and deep drainage phenomena. The uniformity of water distribution into the soil, under sprinkler irrigation, measured by the neutron method, was over 96% even though the uniformity of water distribution at the crop canopy was as low as 76%. Corn yield uniformity follows the uniformity of water distribution into the soil. Water application efficiency was 73% and soil water distribution along the 300 m-long run was over 90% when 108.5 mm of water were applied by furrow irrigation. However, too much water is lost, both by sprinkler and furrow irrigation, when large amounts of irrigation water are applied, or in regions where rainfall is very likely to occur soon after irrigation. The experimental results show that the neutron method can be used in water application efficiency studies with good results below a soil depth of from 20 to 30 cm. (auth)

Site Surveys

Refer also to abstracts 17849 and 18002.

15512 (ARH-2657) RATTLESNAKE RIDGE PROJECT: A PROGRESS REPORT. Price, W. H. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 30 Oct 1972. Contract AT(45-1)-2130. 16p. Dep. NTIS $4.00.

Initial results of a geologic examination of the southeastern end of Rattlesnake Ridge suggest this portion of the ridge is an asymmetrical anticline plunging southeast. A smaller parallel anticlinal structure is believed to be present to the northeast of the Ridge. No major fault was found. Six distinct basalt members similar in appearance and composition to: Rosa and/or Frenchman Springs flows, Priest Rapids flows, Umatilla flow, Pomona flow, Elephant Mountain flow and Ward Gap flow crop out in this area. The stratigraphy and structure of the study area were defined field observation, chemical analysis of the basaltic flows, and review of a gas well log. (auth)

15513 (BMI-171-154) FRESHWATER VERTEBRATE AND INVERTEBRATE ECOLOGY OF AMCHITKA ISLAND, ALASKA. Final Summary Report and Progress Report, July 1, 1972–September 30, 1973. Amchitka Bioenvironmental Program. Neuhold, J. M.; Helm, W. T.; Valdez, R. A. (Utah State Univ., Logan (USA)). Contract AT(26-1)-171. 52p. Dep. NTIS $5.75.

For Battelle Columbus Labs., OH.

Dolly Varden and threespine stickleback were the most abundant and well-distributed of the six freshwater species of fishes encountered on Amchitka. Small runs of pink salmon occurred in late August in about 15 streams on good (even) years and about 6 on poor (odd) years. Coho salmon and freshwater Aleutian sculpin were limited in distribution to five and one streams, respec-

tively; sockeye salmon were rare. Dolly Varden accounted for the greatest biomass of the secondary and tertiary consumer levels on the Island. The two underground nuclear tests (Milrow and Cannikin) affected only local populations of fishes. Deaths due to test-induced pressure changes occurred only as far as 2,000 m from SZ but these effects were specific to threespine stickleback since they were the only fish species with an air bladder intolerant to rapid pressure adjustment (physoclistores). The only loss of Dolly Varden resulted from watershed and pond alterations that drained streams and ponds during Cannikin. More widespread and persistent effects on freshwater biota resulted from pretest construction and drilling activities. Detectable changes in fish and invertebrate populations resulted in four streams near the four drill sites from increased siltation and from the release of drilling residue. Two of the streams, White Alice and E-site Creek, were completely void of life subsequent to the spills; there is a possibility of recovery in the former. Clevenger Creek and Falls Creek demonstrated trends toward recovery of invertebrate and fish populations less than 2 years after spills. (auth)

15514 (DOCKET-701257-6) URANIUM OXIDE FUEL PLANT. AEC Final Environmental Statement. (Automation Industries, Inc., Richland, Wash. (USA). Vitro Engineering Div.). 5 Jun 1974. 221p. Dep. NTIS $14.25.

The Mixed Oxide Fuel Plant, MOFP, owned and operated by the Exxon Nuclear Co. was completed in Oct. 1971 and is located adjacent to the USAEC Hanford Reservation. The MOFP is engaged in process development and limited production of mixed oxide fuel assemblies for light water-cooled and -moderated nuclear power reactors. The final environmental statement for the MOFP includes information on the site environment, description of the plant and its effluents, environmental impact of site preparations and plant construction, impact of plant operation, impact of accidents, unavoidable adverse effects, and irreversible and irretrievable commitments of resources. (LCL)

15515 (EPA-600-5-74-2) REVIEW OF ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGIES. Warner, M. L.; Preston, E. H. (Washington Environmental Research Center, D. C. (USA). Implementation Research Div.). Apr 1974. Contract 68-01-1871. 35p. GPO $0.70.

Seventeen tools or methodologies designed for or applicable to the preparation of environmental impact statements are reviewed to identify their strengths, weaknesses, and potential range of use. Specific criteria are suggested for evaluating the adequacy of an impact assessment methodology in terms of: impact identification; impact measurement; impact interpretation; impact communication; resource requirements; replicability; and flexibility. The reviews presented serve as an introduction to the range of tools available and demonstrate that no single approach to impact assessment is superior in all circumstances. (auth)

15516 (EPA-600-5-74-6) ENVIRONMENTAL IMPACT REQUIREMENTS IN THE STATES: NEPA's OFFSPRING. Trzyna, T. C. (Washington Environmental Research Center, D. C. (USA). Implementation Research Div.). Apr 1974. Contract 68-01-1818. 84p. GPO $1.30.

There is a growing trend in the States to adopt requirements for environmental impact statements like those in the National Environmental Policy Act of 1969. Fifteen States and Puerto Rico now require impact statements for a wide range of activities significantly affecting the quality of the environment, and several others apply the process to limited classes of projects. At least twenty other States have such requirements under consideration. The State requirements are summarized and compared to each other and to the national act. Some key issues are discussed: contents of the impact statement, applicability to private projects and local governments, relation to land use regulation, enforcement, and citizen participation. There are many problems involved in adapting the impact requirement to State needs and institutions. More evaluation of State programs is needed, and a new organization should be created to facilitate communication among the States on administration of impact statement programs. (auth)

15517 RADIATION HAZARD CONTROL SYSTEM. Miki, R.; Morishima, H.; Koga, T.; Honda, Y. (Kinki Univ., Fuse, Japan). Kinki Daigaku Genshiryoku Kenkyusho Nenpo; 9: 37-47([nd]). (In Japanese).

The radiation hazard control system in Atomic Power Research Institute of Kinki University from 1970 to 1972 fiscal year is described. Subjects undergoing personnel monitoring were 46, including 25 technical personnel and 21 students. Leukocyte and erythrocyte counts, the amount of hemoglobin, and the percentage of leukocyte were examined. Physical examination revealed no radiation hazard. No subject received maximum permissible dose. (JA)

Thermal Effluents

Refer also to abstracts 15330, 17696, 17886, 18001, and 18002.

15518 (ANL/ES-18) ANALYTICAL MODELING OF THERMAL DISCHARGES. A Review of the State of the Art. Benedict, B. A.; Anderson, J. L.; Yandell, E. L. Jr. (Argonne National Lab., Ill. (USA)). Apr 1974. Contract W-31-109-Eng-38. 321p. Dep. NTIS $7.60.

Available techniques for mathematical modeling for discharges of heated waters into rivers and lakes and for the operation of cooling ponds are described. General factors affecting heated-water discharges are discussed, including entrainment and diffusion, receiving-water stratification and flow rate, among others. The general elements of the heat budget are also reviewed. For all models presented, assumptions and model limitations are included, along with the basic theory, necessary equations, available verification, and numerical examples. Solutions are included for important cases of the warm-water wedge. Four models for surface discharges of heated water are reviewed in depth. Several others are referenced. Submerged discharges, both single and multiple port, are covered. Both round and slot jets are included, and the availability of models for stratified and nonstratified receiving waters, and for stagnant or flowing receiving waters, is considered. For the single-port discharges, as well as the surface-discharge models, means of estimating times of exposure are presented. Cooling-pond analysis emphasizes idealized pond behavior, with discussion on the behavior and analysis of real ponds. The effect of choice of evaporation formula on pond design is assessed. (auth)

15519 (ANL/ES-32) FIELD INVESTIGATIONS OF HEATED DISCHARGES FROM NUCLEAR POWER PLANTS ON LAKE MICHIGAN: 1972. Frigo, A. A.; Frye, D. E.; Tokar, J. V. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-Eng-38. 241p. Dep. NTIS $7.60.

A partial compilation is presented of thermal-plume field data collected during 1972 by the Energy and Environmental Systems Division of Argonne National Laboratory. Thirty thermal plumes are presented, 15 each for the Point Beach and Palisades Nuclear Power Plants—both located on Lake Michigan. The 1972 data, together with studies performed in previous years, were obtained to demonstrate the variability of plume configurations under a wide range of environmental conditions and collectively are being used to test the validity of several widely used predictive model formulations. General observations of the field data in relation to ambient lake and meteorological conditions are presented here. However, a more detailed analysis of the data will be reported separately. (auth)

15520 (COM-74-10313) WASTE HEAT UTILIZATION. A Bibliography With Abstracts. Report for 1964—November 1973. Ringe, A. C. (National Technical Information Service, Springfield, Va. (USA)). Jan 1974. 30p. (NTIS-WIN-74-15). Dep. NTIS $20.00.

The bibliography contains 25 selected abstracts of research reports retrieved using the NTIS on-line search system—NTISearch. Reports covered include studies of total energy systems, waste heat boilers, utilization of waste heat for sewage treatment, and other beneficial uses and effects of waste heat, especially that rejected by electric power plants. (auth)

15521 (MIT-EL-73-13) THERMAL POLLUTION ABATEMENT EVALUATION MODEL FOR POWER PLANT SITING. Shiers, P. F.; Marks, D. H. (National Technical Information Service, Springfield, Va. (USA)). Feb 1973. 351p. (PB-228739).

For National Science Foundation, Washington, D. C.

A thermal pollution abatement model for power plant siting is formulated to evaluate the economic costs, resource requirements, and physical characteristics of a particular thermal pollution abatement technology at a given site type for a plant alternative. The model also provides a screening capability to determine which sites are feasible alternatives for development by the calculation of the resource requirements and a check of the applicable thermal standards, and determining whether the plant alternative could be built on the available site in compliance with the thermal standards. The thermal pollution evaluation model analyzes the abatement technologies of surface discharge, diffuser, cooling pond, spray canal, and wet mechanical draft cooling towers. The typical site types evaluated are a river, small lake, great lake, coastal estuary, offshore ocean, and water poor site. The model will be used in conjunction with a Plant Evaluation Model, which analyzes the effects of fuel costs and air pollution abatement, a Plant Expansion Model, and a Generation Expansion Model to determine the optimal operating and generating plan for an electric utility. The model may also be used in conjunction with the

Plant Evaluation Model to evaluate the trade offs between the dollar cost of electric power generation, reliability, and air and thermal pollution. The model may also be used to determine, for a single plant site alternative, which abatement technologies would be feasible, and to make an economic and resource requirement comparison between these alternatives. Finally, the model could be used to examine the economic and locational aspects of the implementation of a plan limiting the waste heat discharge to natural bodies to zero discharge. (auth)

15522 (ORNL-tr-2760) WATER AND LITTORAL VEGETATION OF THE GoGRES RESERVOIR-COOLER NAMED FOR A. V. VINTER. Lukina, E. V. Translated by E. J. Zuckerman from Biol. Vnutr. Vod, Inform. Byull.; No. 15, 17-21(1972). 4p. Dep. NTIS $4.00.

The reservoir-cooler of the A. V. Vinter Gorky State Regional Power Plant was created in 1925–1930 at the site of the small, marshy Zhelegnitsa River. It is a reservoir with a reversible system, its area about 200 hectares, its length about 15 km. In 1968–1969 a geobotanical examination of the reservoir was carried out. The heightened thermal level of the reservoir, increasing the period of vegetation to 9 to 12 months, its shallowness, the weak current, and other factors are conducive to high productive levels by groups of water and littoral plants. (MCG)

15523 (ORNL-tr-2768) MICROBIOLOGICAL CHARACTERISTIC OF THE HEATED WATERS OF THE KONAKOVSK POWER STATION. Vainshtein, M. B. Translated by E. J. Zuckerman from Biol. Vnutr. Vod, Inform. Byull.; No. 11, 19-22(1971). 3p. Dep. NTIS $4.00.

Samples of water from the discharge canal to the gulf were analyzed for microorganisms. Membrane filters were used for determining quantities of bacteria; a maximum quality was found at the mouth of the gulf. Dark assimilation of CO_2 was measured using a radiocarbon method. Studies on photosynthesis in algae with the aid of ^{14}C showed a decrease in the direction from the gulf to the channel. Studies on the effects of temperature on photosynthesis were also conducted. (HLW)

15524 (ORNL-tr-2770) PECULIARITIES OF FEEDING OF BREAM IN THE RESERVOIR-COOLER OF THE LITOVSK POWER STATION IN WINTER. Ratchunas, L. A. Translated by E. J. Zuckerman from Biol. Vnutr. Vod, Inform. Byull.; No. 11, 54-55 (1971). 2p. Dep. NTIS $4.00.

An increased growth of algae and invertebrates was observed in the heated water of the lake serving as the reservoir cooler of the Litovsk power station. Analysis of the stomach contents of bream showed that annelid worms and chironomid larvae were the principal food. The increased feeding activity of the bream during the winter season resulted in a significant increase in growth of the fish. (HLW)

15525 (ORNL-tr-2772) INFLUENCE OF OUTFLOW WATERS OF THE KONAKOVSK POWER STATION ON THE HEAT CONTENT OF THE IVANKOVSK RESERVOIR. Kurdina, T. N.; Butorin, N. V. Translated by E. J. Zuckerman from Biol. Vnutr. Vod. Inform. Byull.; No. 11, 65-68(1971). 4p. Dep. NTIS $4.00.

Temperature surveys were carried out during the period from 1967 to June 1969 in the Ivankosk reservoir near the Konakovo hydroelectric plant to detect changes in the heat content of the water and the effects of warm water discharged from the power plant on thermal conditions in the reservoir. The results showed that even with the electrical plant not operating at full capacity there was a sharp increase in the overall heat content of the reservoir due to the discharge of warm water. (LCL)

15526 MARINE ENVIRONMENTAL INTERACTION WITH AN OFFSHORE NUCLEAR POWER PLANT. Kylstra, C. D. (Univ. of Florida, Gainesville); Bunker, P. L. Trans. Amer. Nucl. Soc.; 18: 45-46(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15527 COLD SHOCK: TOLERABLE TEMPERATURES AND GUIDANCE FOR POWER PLANTS. Coutant, C. C. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 47-48(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15528 COMPUTER-MODEL FOR THREE-DIMENSIONAL SIMULATION OF THERMAL DISCHARGES INTO RIVERS. Till, H. A. (Univ. of Missouri, Rolla); Kalinowski, J. E. Trans. Amer. Nucl. Soc.; 18: 54-55(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15529 TIDAL TRANSIENT FAR-FIELD MODEL FOR OFFSHORE THERMAL DISCHARGES. Eraslan, A. H. (Univ. of Tennessee, Knoxville); Siman-Tov, M. Trans. Amer. Nucl. Soc.; 18: 55-57(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15530 THERMAL PLUMES FROM INDUSTRIAL COOLING WATER. Waldrop, W. R.; Farmer, R. C: (Louisiana State Univ., Baton Rouge). pp 266-286 of Proceedings of the 1974 Heat Transfer and Fluid Mechanics Institute. Davis, L. R. (ed.). Stanford, CA; Stanford Univ. Press (1974).

From Heat Transfer and Fluid Mechanics Institute conference; Corvallis, Oregon, USA (12 Jun 1974). See CONF-740613-.

Thermal plumes of industrial cooling water discharged into rivers and lakes are discussed. Results of two cases, computed by an unsteady, three-dimensional finite-difference technique, are shown as isotherms, velocity vectors, and float lines. The first case shows unsteady flow of hot water discharged during a startup operation of a plant. A more efficient calculation procedure is demonstrated for obtaining a steady flow solution. Hot water tended to flow around an eddy on the leeward side of the plume and remain near the bank as it flowed downstream. A discharge from Point Beach Nuclear Power Plant is also discussed. Although discharged at an angle to the shore with no current in the lake, the flow tended to turn normal to the shore. A complex pair of asymmetric buoyant vortices also developed. These flow characteristics appear to be confirmed by published field data. (auth)

15531 RESEARCH NEEDS IN WATER QUALITY CRITERIA, 1972. Washington, DC; National Academy of Sciences (1973). 75p.

Attention is focused on important aspects of water quality for which information is inadequate for satisfactory understanding of quality requirements and criteria pertaining to beneficial uses of the nation's water resources. Topics covered include: recreation and athletics, public water supply, freshwater aquatic life and wildlife, marine aquatic life and wildlife, agricultural uses of water, and industrial water supplies. (177 references) (MCG)

15532 ELECTRIC POWER PLANTS IN THE COASTAL ZONE: ENVIRONMENTAL ISSUES. Clark, J.; Brownell, W. American Littoral Society Special Publication No. 7. Highlands, NJ; American Littoral Society(1973). 112p.

Environmental disturbances caused by open-cycle cooling systems of steam electric plants that draw massive quantities of water from public water bodies to cool steam condensers were studied. Topics covered include: estuarine ecology, power plant design, vulnerability of estuarine biota, impacts internal to the plant, impacts external to the plant, federal regulations, and solutions. It was concluded that thermal pollution is not the leading adverse environmental effect from power plants, but the invisible death of masses of small aquatic life that are drawn into the plants with the huge volumes of cooling water withdrawn from public waters. Solutions advanced for this problem are: to locate power plants along the open coast where there is deep water nearby for strategic placement of intake and outlet structures and to reduce the volume of cooling water by requiring plants to use closed-cycle systems which recirculate cooling waters. (MCG)

15533 STUDIES ON THE POPULATION DYNAMICS OF HELMINTH PARASITES IN THE YELLOW-BELLIED TURTLE, PSEUDEMYS SCRIPTA SCRIPTA. Bourque, J. E. Winston-Salem, NC; Wake Forest Univ. (1974). 120p. University Microfilms Order No. 74-8921.

Thesis (Ph. D.).

The objectives were: to determine whether the distribution and abundance of gastro-intestinal helminth parasites in the Yellow-bellied turtle, Pseudemys s. scripta, is related to thermal modification of its habitat; to determine potential causes of an alteration in parasitism and to critically examine the abundance of acanthocephalan parasites (Neoechinorhynchus spp.) in relation to three models of parasite population dynamics: regulation by the host, environment and parasite. Among habitats significant differences in the mean number of parasites of several species were noted, but the direction of the response of each species was not the same; their response was also related to habitat type (i.e., ponds vs. river-swamps). Camallanus trispinosus showed a significant increase in turtles from ponds which were recovering from previous thermal loading. Another nematode, Spironoura chelydrae, showed a significant increase in hosts from river-swamps undergoing post-thermal recovery. For these nematode parasites, and two groups of trematodes, Telorchis spp. and Macravestibulum obtusicaudatum, the burden per host was decreased in a pond currently receiving thermal effluent. Several species of acanthocephala were also decreased in thermal ponds, but Neoechinorhynchus emyditoides was substantially increased. The relationship between thermal loading and parasitism is obviously complex. To gain an understanding of what factors might be influential in regulating parasite burdens, the population

characteristics of Neoechinorhynchus spp. were examined in more detail. Compared with other helminth parasites, Neoechinorhynchus spp. showed a relatively high positive correlation with host weight, size (plastron length) and small intestine length. However, only 15 to 25 percent of the variability in Neoechinorhynchus spp. burdens could be accounted for by these host variables. Release of parasite-free hosts in the thermal pond and a recovery pond allowed an estimate to be made of the average input rate of Neoechinorhynchus spp. The mean (S. E.) of worms entering per day of exposure was 0.77 (0.31). Minimum growth rates of male and female Neoechinorhynchus spp. in the definitive hosts were determined. Female neoechinorhynchiids grew faster (0.214 mm per day) than males (0.163 mm per day). Moreover, the disparity between growth rates was more apparent as worms increased in size. (Diss. Abstr. Int., B)

15534 BIOLOGICAL EFFECTS OF COOLING WATER DISCHARGE FROM NUCLEAR POWER PLANTS. Important to Arrive at Total Evaluation. Skulberg, O. M. Tek. Ukebl.; 121: No. 20, 52-58, 62(9 May 1974). (In Norwegian).

The effects of cooling water discharge from nuclear power plants are discussed with special reference to the effects in coastal waters, and in particular, to Oslofjord and similar partially landlocked bodies of water with relatively little circulation to the adjacent sea areas. The effects of the release of radioactive corrosion products and possibly fission products will probably be negligible, but critical isotopes, critical pathways, and food chains should be studied in order to estimate the capacity of the recipient. The thermal effect of the discharge will lead to increased algae and plankton growth and will disturb the balance of species in the fish population. All such changes must be assumed to be detrimental. In the presence of nutrient pollutants oxygen starvation may occur, or antipollution measures be neutralized. It is however possible, under controlled conditions that thermal discharges may be utilized in fish and sea food cultivation. (NO)

15535 THERMAL LOADING OF THE SURFACE WATERS BY ELECTRIC POWER STATIONS IN THE FEDERAL REPUBLIC OF GERMANY. Bueker, H. (Kernforschungsanlage, Juelich, Ger.). pp 42-47 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

By transferring present estimations made with regard to the river Rhine to the other rivers of the Federal Republic of Germany, it becomes evident that about half of the number of additional power stations required by 1980 will fully exhaust the remaining heat-absorption capacity. The upper limit estimated for simultaneous removal of water as additional water for the wet back-cooling process is in the range of 3% NQ (low water). With a view to any further increase in the number of power plants, both of these water-based cooling processes will consequently have to be replaced by the dry air-cooling system. Even raising the limit of water removal to 5% or 7% NQ could merely delay this change-over by approximately 2 or 4 years. (auth)

15536 ENERGY CONSERVATION THROUGH WASTE HEAT UTILIZATION. Kirchner, R. P.; Stamper, E. (Newark Coll. of Engineering, NJ). pp 155-159 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

Possible beneficial uses of waste heat from power plants are discussed, including uses in agriculture, residential and industrial space heating and cooling, water treatment, and recreational uses. Urban, rural, and off-shore power plant sites are considered. It is concluded that the economics of power generation is such that none of the proposed uses has represented an economical integration of waste heat utilization in the power plant design. As the cost of fuel increases and as the demand for electric power rises, the effect of waste heat being dumped into the environment will become more critical. We will begin to see more and more power plants designed to include the use of one or more of the cited waste heat utilization methods, as well as other ones. The current laws requiring Environmental Impact Statements and the growth of Technology Assessment as an engineering tool will work to promote the use of waste heat from power plants. (LCL)

15537 ENVIRONMENTAL STUDIES OF HEATED DISCHARGE IN COASTAL ZONES. Ahn, C. S.; Smith, P. F. (EG and G, Inc., Waltham, MA). pp 160-166 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

The need for environmental studies of heated discharges into coastal zones leading to adequate and verified predictive tools upon which informed and balanced decisions can be based is considered. These stated needs evolve around a number of areas which include: the demand for energy; the demand for environmental protection; the recognition of the importance of the coastal zone; the practical needs for predictive tools based upon an understanding of the physical and biological processes involved in the coastal zone (especially adequately validated and accepted predictive tools); the immediate needs of regulatory and standard setting groups for evaluating environmental impact statements and establishing criteria; and finally the practical needs of power plant engineers themselves to carry out their work of providing generating capacity within the demands of society for environmental protection. The present study of heated discharges into coastal waters is aimed at both the technical and the information exchange and use aspects of this serious environmental problem. The present paper reviews the technical aspects of the work to date. (auth)

Chemical Effluents

Refer also to abstracts 14748, 14761, 14762, 14766, 15083, 15371, 15384, 15531, 15532, 16073, 17886, and 18110.

15538 (AERE-R-6983) RESULTS OF THE TEES-SIDE INVESTIGATION. Eggleton, A. E. J.; Atkins, D. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1972. 186p. Dep. NTIS (US Sales Only) $12.50. UK £3.50.

The results are described of an intensive investigation during the period 1967 to 1970 into the occurrence of mist in the Tees-side area and its relation to meteorological conditions and pollutant emissions. Several mist episodes occurred during the investigation in association with natural sea-mist affecting much of the N. E. coast of Britain. These episodes were made worse on many though not all occasions by the presence of ammonium sulfate formed in the atmosphere by reaction between ammonia emitted from chemical plant in the area and sulfur dioxide from combustion of fossil fuel. The mean levels of ammonium sulfate on Tees-side were no greater than expected for an area of comparable industrialisation elsewhere but it was concluded that so long as emissions of ammonia and sulfur dioxide were sufficiently high then episodes of polluted fog with high peak concentrations of ammonium sulfate were likely to occur. Much has been done recently to reduce emissions of ammonia and sulfur dioxide and no serious episode of polluted fog has occurred since the investigation. Experience not only on Tees-side but also in several coastal cities overseas suggests that due regard must be paid to the special meteorological conditions prevailing in coastal locations and full advantage taken of modern techniques of air pollution control if episodes of high pollution and polluted fogs in such areas are to be minimized. (auth)

15539 LABORATORY MODEL ECOSYSTEM FOR EVALUATING THE CHEMICAL AND BIOLOGICAL BEHAVIOR OF RADIOLABELLED MICROPOLLUTANTS. Metcalf, R. L. (Univ. of Illinois, Urbana). pp 49-63 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

A standardized laboratory model ecosystem was used to evaluate the comparative behavior of radiolabelled micropollutants that include: organochlorine, organophosphorus, carbamate, and hormone-mimic insecticides; herbicides; important industrial organic compounds including phthalate esters and PCB's; and specific pollutants such as TCBD and hexachlorobenzene. The compounds were studied for ecological effects over a terrestrial-aquatic interface and through several food chains, especially with regard to the development of quantitative information on ecological magnification and biodegradability index. The pathways of chemical degradation in the various organisms were evaluated and the ecological effects of degradation products investigated. Illustrations are given of the use of the model ecosystem technology for screening new candidate pesticides for effects on environmental quality, for evaluating the hazards of environmental pollution by industrial waste effluents and for fundamental studies of the principle of biodegradability of organic chemicals in a variety of organisms. (auth)

15540 APPLICATION OF CRITICAL PATH ANALYSIS TECHNIQUES TO THE ASSESSMENT OF ENVIRONMENTAL

CAPACITY AND THE CONTROL OF ENVIRONMENTAL WASTE DISPOSAL. Preston, A. (Ministry of Agriculture, Lowestoft, Eng.). pp 573-583 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The United Kingdom has pioneered the use of critical path analysis techniques in the assessment and control of radioactive waste disposal problems. Its experience with the application of these techniques to this type of assessment in the context of aquatic environments is extended to other environments and other pollutants, and discussed. The requirements for quantitative information on the relevant parameters employed in the analysis are reviewed and their application to control and monitoring needs outlined. The applicability of these principles and techniques to the assessment and control of other pollutants entering the environment is assessed. The special problems of monitoring the levels of pollutants in relation to the control of damage to marine resources, and in particular the need to provide better criteria of the potential significance of many marine pollutants, in both a human and natural resource context, are stressed. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 15903, 15907, 15983, 16011, 16021, 16028, 16484, 17327, and 17759.

15541 (ANL-8080, pp 10.1-10.17) APPLICATIONS OF MULTIWIRE PROPORTIONAL CHAMBERS TO BIOPHYSICS AND MEDICINE. Perez-Mendez, V. (Univ. of California, Berkeley); Kaplan, S. N.; Valentine, K.; Kaufman, L.; Blumin, L.; Cavalieri, R. 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

Multiwire proportional chambers with electromagnetic delay-line readouts were developed at the Lawrence Berkeley Laboratory originally as particle track detectors. In the meantime they have been used for imaging x-ray and γ-ray distributions in medical applications by filling the chambers with xenon gas at a few atmospheres pressure and adding drift regions to provide greater detection efficiency. Other medical applications besides the nuclear medicine isotope imaging include the use of neutrons for radiography. In biophysical applications they have been used as detectors of x-ray diffraction patterns in crystallographic studies of complex organic crystals and in radioactive chromatography. (auth)

15542 (BNWL-1742) TECHNOLOGICAL CONSIDERATIONS IN EMERGENCY INSTRUMENTATION PREPAREDNESS. Phase II-B. Emergency Radiological and Meteorological Instrumentation for Mixed Oxide Fuel Fabrication Facilities. Andersen, B. V.; Carter, L. A.; Droppo, J. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-1830. 106p. Dep. NTIS $5.45.

A model fuel fabrication plant capable of producing one metric ton per day of mixed oxide fuel enriched to 2 to 4% with PuO_2 was examined to determine the source and magnitude of postulated releases of plutonium to the environment in the event of accidents within the plant. Based on this examination, performance criteria were developed for instrumentation systems to (1) immediately detect the occurrence of a release, (2) determine the magnitude of and direction taken by the release, and (3) permit estimation of the impact of the release on the environs of the plant. (WHK)

15543 (CONF-730804-P4, pp 2697-2702) ROCKET BORNE INSTRUMENT FOR THE STUDY OF SOFT X-RAY EMISSION FROM COSMIC-RAY SOURCES. Agrawal, P. C.; Moore, W. E.; Garmire, G. P. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Details about a rocket borne instrument designed for studying the various characteristics of soft x-ray emission from cosmic x-ray sources in the energy range (0.2 to 3) keV are presented. The x-ray detector consists of a bank of four multilayer, wall-less proportional counters, each with an area of ~400 cm^2. The detectors are covered by windows of ~1.4 μ polypropylene and are maintained at a constant pressure in flight using a gas control system. Two of the detectors are equipped with 0.4° × 10° collimators for mapping the spatial distribution of soft x-rays from extended x-ray sources. A pair of balanced filters consisting of oxygen and CF_4 are used for detecting oxygen emission lines. (auth)

15544 (CONF-730804-P4, pp 2709-2714) BALLOON BORNE SOFT GAMMA-RAY TELESCOPE. Schoenfelder, V.; Lichti, G. (Max-Planck-Inst. fuer Physik, Garching, Ger.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A balloon borne soft gamma ray telescope is described. The instrument has been used for the measurement of the diffuse primary electromagnetic spectrum in the MeV-range. Principle of measurement is the double Compton process. The detector consists of two large plastic scintillator blocks 1.20 m apart. A gamma ray event is identified by a Compton collision in the upper detector, followed by a second scattering in the lower crystal, the sequence being confirmed by a time of flight measurement. The advantage of this new method is its low sensitivity to undesired background events. The telescope has an opening half angle of 15° (HWHM), an energy resolution of 20% (HWHM), and a detection efficiency of 0.5%. (auth)

15545 (CONF-730804-P4, pp 2716-2721) LIQUID-XENON COMPTON TELESCOPE. New Technique for Gamma-Ray Astronomy. Dauber, P. M.; Smith, L. H. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A new technique for gamma-ray astronomy in the difficult but important energy decade from 0.3 to 3.0 MeV is proposed. Cosmic gamma rays Compton scatter in a liquid-xenon wire proportional chamber recently developed at Lawrence Berkeley Laboratory (Derenzo, et al., 1972; Muller, et al., 1971) and then are totally absorbed in a second chamber. The energy and position of each interaction is recorded for each gamma ray. This information determines a circle on the celestial sphere which must intesect the source position. A localized source of gamma-rays would show itself as the intersection of many such circles. It is expected to locate sources to a fraction of a square degree in a balloon-borne sky survey experiment using an instrument with a one steradian acceptance. (auth)

15546 (CONF-730804-P4, pp 2722-2726) DETECTION METHODS FOR GAMMA-RAY SOURCES IN THE ENERGY RANGE 1 TO 10 MeV. Baker, R. E.; Burnell, S. J.; Lovett, R. R.; Orford, K. J.; Ramsden, D. (Univ. of Southampton, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A study has been made of methods for investigating celestial gamma-ray sources from balloon altitudes in the energy range 1 to 10 MeV. In the light of recent developmental flights, the performance of a number of detector types has been evaluated in a search for the design for a sensitive directional detector. (auth)

15547 (CONF-730804-P4, pp 2738-2741) SOLAR NEUTRON DETECTOR. Kim, C. Y. (Univ. of Calgary, Alberta, Canada). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A hodoscope type detector which consists of very thin walled plastic scintillator pipes is being built to observe the solar neutrons belonging to the board maximum (20 to 80 MeV) of the spectrum. The detector can measure simultaneously the energy and the direction of motion of incident neutrons by photographing two recoil proton tracks which are produced by two successive elastic scatterings of neutrons at hydrogen nuclei. The pipes are acting in quadruple roles: triggering scintillator, target, neon flash tube, and range definer. (auth)

15548 (CONF-730804-P4, pp 2786-2789) MOUNTAIN ALTITUDE COSMIC-RAY MASS SPECTROMETER. Bowen, T.; Barber, B.; Jenkins, E.; Jones, J.; Pifer, A.; Thompson, N. (Univ. of Arizona, Tucson). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A cosmic ray mass spectrometer having a superconducting magnet, digitized wire spark chambers, and scintillation counters for time of flight measurements and shower detection is being readied for operation at an altitude of 2750 meters. The apparatus will be particularly sensitive to particles with masses above the nucleon mass and of either integral or fractional charge. Initially the experiment will concentrate on measuring the relative intensities of deuterons, tritons, and anti-protons in the cosmic rays at mountain altitude. The experiment will also search for hypothetical new long-lived particles with masses above the nucleon mass. (auth)

15549 (CONF-730804-P4, pp 2790-2795) CONCERNING THE MULTIPLICITY YIELD FUNCTION OF THE NM-64 NEUTRON MONITOR. Debrunner, H.; Flueckiger, E. (Univ. of Bern). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The multiplicity yield function of the NM-64 neutron monitor has been calculated for multiplicities $1 \leq m \leq 20$, for the atmospheric depths h = 650, 1033 g cm^{-2}, for the primary zenith angles $\vartheta_0 = 0°$, 24°, 48°, and for ten rigidities in the range 2.2 GV $\leq R_0 \leq$ 100 GV. From these calculations quantities have been derived which can be compared with experimental data. The agreement between our

theoretical results and the measurements is quite good, showing that our analysis is a valuable supplement to neutron monitor latitude surveys. Furthermore, additional information has been obtained about the mean free path of high energy nucleons in the atmosphere and about the low-energy neutron production in lead. (auth)

15550 (CONF-730804-P4, pp 2796-2801) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF SILICON DIOXIDE AS PRODUCER, MODERATOR, AND REFLECTOR IN NEUTRON MONITORS. Quang, T. T.; Fenton, A. G.; Fenton, K. B. (Univ. of Tasmania, Australia). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The Monte Carlo technique is employed to investigate the possibility of using silicon dioxide as the reflector, moderator and producer of a neutron monitor. It is found experimentally that a 105 cm × 160 cm × 276 cm concrete brick stack (consisting mainly of SiO_2) containing two large Chalk River (PB28) BF_3 counters, spaced 46 cm apart, yields an average count-rate near sea level of ~9000 c/hr per counter. The average multiplicity of this monitor is 1.03 ± 0.03. Its detection efficiency is 3.1 ± 0.3%. Seven months' data collected from this arrangement yield an atmospheric attenuation coefficient of 0.970 ± 0.002%/mm Hg for the nucleonic component. Forbush decreases, solar flares and 27-day variations have been observed within this period. An altitude-intensity survey with a mobile monitor of this type is in preparation. (auth)

15551 (CONF-730804-P4, pp 2803-2809) METHOD FOR SOURCELESS CALIBRATION OF INSTRUMENTS FOR COSMIC-RAY INTENSITY DETECTION. Blokh, Y. A.; Dorman, L. I.; Libin, I. Y. (IZMIRAN, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A method for automatically determining the corrections in neutron monitor and telescope data without using radiation sources is proposed. The relation has been obtained between the cosmic ray intensity changes and the changes in the thresholds of each channel, with the instrumental errors being determined as a function of detected intensities for the various thresholds combinations. A method for continuous determination of the telescope effectiveness using another telescope with the operating telescope inside is proposed. (auth)

15552 (CONF-730804-P4, pp 2848-2853) EXPERIMENTAL ANALYSIS OF CELLULOSE NITRATE AND LEXAN-POLYCARBONATE AS COSMIC-RAY PARTICLE DETECTOR. Enge, W.; Grabisch, K.; Dallmeyer, L.; Bartholome, K. P.; Beaujean, R. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The track and the bulk etching rates (v_t and v_b) of Lexan-polycarbonate and cellulose nitrate have been studied under variation of the etching parameters like temperature, etchants, normalities and mechanical stirring. The track etching of both detectors is independent of the mechanical stirring of the etchant. In Lexan at 70°C the etching solution inside a cone is saturated with etched products. For Lexan the ratio v_t/v_b is only a function of the energy loss (REL), it is independent of the normalities and the temperature of the NaOH solution. The etching behavior of cellulose nitrate is more complicated. (auth)

15553 (CONF-730804-P4, pp 2855-2860) AgCl PARTICLE TRACK DETECTORS. Schopper, E.; Granzer, F.; Haase, G.; Haseganu, D.; Henig, G.; Schott, J. U.; Wendnagel, F.; Zorgiebel, F. (Univ. of Frankfurt, Main and Munich, Ger.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Improvements of the technology and the detecting properties have been achieved since the Hobart-Conference in 1971. The detectors, usually consisting of 200 to 300 micron thick layers of Cd-doped silverchloride on quartz-glass, can now be produced with larger sizes up to 4 × 15 cm, and as free foils. The fading of unrevealed tracks and their stabilization by yellow light—important factors for triggering the record of particle tracks and for the selection or the time assignment of events—have been investigated in more detail: The fading is strongly influenced by the temperature of the detectors during operation, the time constant of fading being decreased by approximately an order of magnitude with an increase of $\Delta t = 5$ K of the temperature. Track-parameters for the discrimination of particles (Z,E) have been elaborated from calibrations with accelerated heavy ions and with cosmic rays from balloon flights. Preliminary results are presented with detectors flown (without triggering facilities) in Apollo 17. (auth)

15554 (CONF-730804-P4, pp 2878-2882) CALCULATION OF ENERGY LOSS BY HIGHLY CHARGED PARTICLES AND THE INTERPRETATION OF COSMIC-RAY DATA. Eby, P.; Morgan, S. H.; Parnell, T. A. (Marshall Space Flight Center, Huntsville, AL). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The use of the Born approximation in describing the energy loss process for relativistic cosmic rays above Z ~ 20 underestimates the energy loss due to the production of high energy secondary electrons. The implications of this fact for the response of various detectors, such as ion chambers, scintillators, emulsions, and Cerenkov counters is discussed. (auth)

15555 (CONF-730804-P4, pp 2936-2941) VELOCITY DEPENDENCE OF THE PHOTOMETRICALLY DETERMINED TRACK WIDTH OF HEAVY IONS IN ILFORD G5 NUCLEAR EMULSIONS. Larsson, L.; Anderson, R.; Mathiesen, O. (Univ. of Lund, Sweden). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The relation between the photometrically determined track width, W, and the velocity β of some heavy ions with charge numbers Z = 14, 16, 24, and 26 has been established in Ilford G5 nuclear research emulsions. It has been found that in the velocity interval $0.4 \leq \beta \leq 0.8$ the relation between W, Z, and β can approximately be written $W(\beta,Z) = W_0(Z)\,\beta^{-\alpha(Z)}$. The numerical value of $\alpha(Z)$ is about one. From the empirical function $W(\beta,Z)$ we can derive the rate of change of W along the track. (auth)

15556 (CONF-730804-P4, pp 2954-2958) FIELD-IONIZATION NEUTRAL-PARTICLE MASS SPECTROMETER. Curtis, C. C.; Hsieh, K. C.; Fan, C. Y. (Univ. of Arizona, Tucson). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The development of a neutral-particle mass spectrometer for space exploration, applying the techniques of field ionization and single-particle counting is reported. Presently, using a circular magnet of radius 1.27 cm and 8 kG gap density, H, H_2, He, and the C–N–O group can be identified unambiguously with sensitivities 1×10^{10} c s^{-1} $Torr^{-1}$ for H_2, 3×10^8 c s^{-1} $Torr^{-1}$ for He and 2×10^9 c s^{-1} $Torr^{-1}$ for N_2. Work is in progress to improve the sensitivities and the mass resolution without increasing the total power consumption, which is 2W for a 7-detector spectrometer. A single-detector system without magnetic analyzer is under study also. The features of a field-ionization neutral-particle mass spectrometer favour the adoption of such an instrument for interplanetary as well as planetary missions. (auth)

15557 (CONF-730804-P4, pp 3011-3016) RESULTS OBTAINED WITH POSITION SENSITIVE MULTIWIRE PROPORTIONAL CHAMBERS WITH HELIUM, CARBON, AND OXYGEN NUCLEI. Emming, J. G. (Ball Brothers Research Corporation, Boulder, CO); Gilland, J. R.; Godden, G. D.; Smith, L. H.; Zardiackas, F. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Spatial resolution performance results obtained at the Lawrence Radiation Laboratory Bevatron with prototype multiwire proportional chamber spatial detectors with integral delay line readout are presented. The effects due to incident nuclei charge, chamber operating parameters, chamber design, electronics, gas mixtures, and magnetic field presence have been investigated and are discussed. (auth)

15558 (ORNL-TM-4547) UNFOLDING SPATIAL IMAGES FROM A POSITION-SENSITIVE PROPORTIONAL NEUTRON COUNTER. Booth, R. S.; Kopp, M. K.; Timm, G. L.; Swander, J. E. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

A data analysis technique was developed and tested for determining the position and intensity of neutron beams incident upon a position-sensitive proportional counter. Solution of this problem of unfolding data is important to use of the counter in neutron scanning applications. Test data were generated to simulate counts vs y-position for 13 neutron beams, and then they were unfolded by several numerical techniques. The spacing between the beams varied from 1 to 5 cm and their normalized intensity from 0.05 to 1.00. The signature from a single beam covered ≈5 cm, or

≈30 channels of data. Statistical variation due to counting, after subtraction of a constant background, ranged from ≈1% at the peaks of some responses to ≈100% for channels dominated by the background. The most successful technique for unfolding the test data was constrained least-squares fitting, followed by iterative least-squares fitting. The relative positions and intensities of the 13 beams were determined to an estimated accuracy of 0.01 cm and 5%, respectively. Similar results were obtained with simulated data where both the y- and x-positions of the beam were independent variables. It was concluded that the necessity of unfolding counter data for incident neutron beams should not limit the utility of the camera for these beams. (auth)

15559 (RFP-Trans-161) FABRICATION AND CHARACTERISTICS OF THIN-FILM NEUTRON THERMOPILE FOR REACTOR INSTRUMENTATION. Kim, D. H. Translated from J. Korean Inst. Electron. Eng.; 9: No. 5, 220-224(Nov 1972). 6p. Dep. NTIS $4.00.

In order to improve the response time of a neutron thermopile for reactor control, a neutron thermopile that made use of a vacuum evaporated thin film thermocouple was fabricated and tested. The test results were compared with a wire-type neutron thermopile. Good linearities between the response of the neutron thermopile and the thermal flux has been shown in the ranges from 2×10^5 to 8×10^{13} n/cm^2/sec. Thermal neutron flux distributions in the core of TRIGA Mark-II reactor were measured using the fabricated neutron thermopile, and the results are compared with data obtained by the acrivatin foil measurement. (auth)

15560 (UCD-472-120, pp 148-152) DESIGN, THEORY, AND CALIBRATION OF AN ^{125}I DENSITOMETER. Fisher, G. L.; Goldman, M.; Hinz, E. A.; Lee, T. D. Jun 1973.

In annual report, fiscal year 1973.

Iodine-125 photon densitometry can be used to determine the mineral content of a sample of bone in tissue or tissue-equivalent media. Mineral content is a measure of the density of the bone. The technique is accurate and reproducible to better than 1%. A bone densitometer was fabricated utilizing the principles describing the absorption of a monoenergetic photon beam passing through variable atomic number absorbers. The bone scanning system consists of a motor and its controlling circuit, a positioning carriage, detector, multichannel analyzer, interface unit and several recording devices. (auth)

15561 (UCRL-51568) PARTICLE REGISTRATION IN DIELECTRIC MATERIALS: A BIBLIOGRAPHY. Griffith, R. V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1974. Contract W-7405-Eng-48. 183p. Dep. NTIS $7.60.

A bibliography containing 872 references on techniques and applications of registration of nuclear particles in dielectric materials, as well as 30 track registration patents, has been compiled with cross-reference lists by author and key word. About two-thirds of the references include abstracts. (auth)

15562 DEVELOPMENT OF AN ENVIRONMENTAL MONITORING SYSTEM FOR THE ON-LINE DETECTION OF AIRBORNE RADIOACTIVE GASES. Jabs, R. H.; Jester, W. A. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 18: 50-51(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15563 IN-LINE AND OFF-LINE MONITORS OF URANIUM CONCENTRATION IN PROCESS SOLUTIONS. Reilly, T. D.; Cowder, L. R.; Umbarger, C. J. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 52(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15564 PULSE SHAPE DIFFERENCES IN THIN GLASS SCINTILLATORS. Gozani, T. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 67-68(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15565 PULSED ION CHAMBER WIDE-RANGE RADIATION FIELD MONITOR. Kaiser, B. J.; Ellis, W. H.; Sprague, K. E. (Univ. of Florida, Gainesville). Trans. Amer. Nucl. Soc.; 18: 69-70(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15566 ISOTOPIC COMPONENTS OF LIGHT NUCLEI DETECTED WITH PLASTIC DETECTOR. Fukui, K. (AFRC, Bedford, MA); Enge, W.; Beaujean, R. Trans. Amer. Nucl. Soc.; 18: 84(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15567 ANALYTIC APPLICATIONS OF PARTICLE TRACKS. Fisher, D. E. (Univ. of Miami, FL). Trans. Amer. Nucl. Soc.; 18: 84-85(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15568 FURTHER DEVELOPMENTS WITH GLASS DETECTORS FOR HIGH-ENERGETIC HEAVY IONS. Fiedler, G. (Univ., Giessen, Ger.); Siegert, G. Trans. Amer. Nucl. Soc.; 18: 88-90(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15569 INDUCED FISSION TRACKS IN GLASS FROM MONOENERGETIC AND THERMAL NEUTRONS. Carpenter, B. S.; Gilliam, D. M.; Reimer, G. M. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 90(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15570 CALCULATION OF THE GAMMA-RAY RESPONSE OF SELF-POWERED DETECTORS USING MONTE CARLO METHODS. Goldstein, N. P. (Westinghouse Research Labs., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 303-304(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15571 IMPROVED TECHNIQUE FOR UNFOLDING FOIL ACTIVATION DATA. Schmotzer, J. K.; Levine, S. H. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 18: 370-371(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15572 SINGLE STAGE CENTRIPETER FOR RAPID ANALYSIS OF LONG-LIVED ALPHA EMITTERS IN AIR. Kotrappa, P.; Bhanti, D. P.; Dua, S. K.; Joshi, P. P. (Bhabha Atomic Research Centre, Bombay). Health Phys.; 27: No. 1, 103-108(Jul 1974).

Rapid detection of long-lived α emitters such as Pu, U, Th in air is rendered difficult because of the interference of radon and thoron daughter products always present in air. It is known that radon and thoron daughter products are usually associated with the aerosols of particle size less than 0.04 μm, whereas the man-made aerosols are usually larger. This property is made use of in a specially designed single stage centripeter sampling at 1000 l./min. This is found to have collection efficiency for long-lived isotopes around 65% and for short-lived isotopes around 3%. As the sample comes out on a filter paper it is possible to obtain an approximate estimate of contribution from radon/thoron daughter products by counting the sample reversed, taking advantage of the α energy differences between radon and thoron daughter products and U, Th or Pu. Therefore, even this 3% can be determined and discounted. Comparison is made between the present instrument and the annular impactor, an instrument also based on the principle of size separation. It is concluded that this instrument has several desirable features compared to the annular impactor and is better suited for field use. (auth)

15573 LINE SPREAD RESPONSE FOR A SCINTILLATION CAMERA AND MOVABLE FILTER PLATE SYSTEM. Jaszczak, R. J. (Searle Medical Instrumentation Group, Des Plaines, IL). Phys. Med. Biol.; 19: No. 3, 362-372(May 1974).

An analysis is made of a filter scan system using a movable filter plate placed above the normal Anger camera-collimator system to improve overall spatial resolution. The equations necessary to predict the response of the system to a line source placed perpendicularly to a row of filter holes and a distance z_0 from the surface of the system are derived. Extension to a two-dimensional theory is indicated. Equations for the special case (where the source is at the surface of the system) are derived, and a computer program has been written to evaluate numerically the integrals and plot the computed line spread functions. Using these data as input, modulation transfer functions are computed. The modelled line spread functions and the MTFs are compared with those obtained experimentally from the filter scan system. Expressions for relative sensitivities are presented. This model permits a rapid evaluation of filter plates that have, for example, the same relative sensitivity, but differ in hole size and spacing. By generating the line spread response it is possible to determine which filter plate will maximize the system MTF. (auth)

15574 TIME-VARIANT FILTERS IN NUCLEAR ENERGY MEASUREMENTS. Karlovac, N. Knoxville, TN; Univ. of Tennessee (1973). 156p. University Microfilms Order No. 74-11,258.

Thesis (Ph.D.).

This work deals with the application of time-variant filters as shaping filters for signal and noise in nuclear energy measurements with semiconductor radiation detectors. The theory of optimum filtering and the theory of time-variant networks are reviewed and expanded. An experimental energy measurement system with a semitriangular weighting function, incorporating time-variant filters, was developed and theoretically and experimentally investigated. The main emphasis was placed on the detailed analysis of resolution and counting rate performance. Using a Ge(Li) detector, an energy spectrum was measured at 150,000 cps. The pulser resolution was 1.06 keV and the processing time was 6μsec. (Diss. Abstr. Int., B)

15575 METHOD AND APPARATUS FOR MEASURING RADIOACTIVITY OF ORGANIC SUBSTANCE. Saito, T.; Morikawa, N.; Wanatable, K. (to Sagami Chemical Research Center). US Patent 3,811,838. 21 May 1974. Priority date 10 Nov 1971, Japan. 14p.

A radioactive labelled compound is measured quantitatively of its mass by a thermal conductivity detector (TCD) and then passed through a proportional counter to take radioactive measurement. As occasion demands, the compound is decomposed into CO_2 and H_2O and then H_2O is trapped which is then reduced in a furnace by using carbon for preparing H_2, on which quantitative measurement is taken by the TCD and then on which radioactive measurement is taken by the proportional counter. (Official Gazette)

15576 PROPOSED MODEL FOR THE VISUAL DETECTION OF SIGNALS IN RADIOISOTOPE DISPLAY IMAGES. Sharp, P.; Mallard, J. (Aberdeen Univ., Scotland). Phys. Med. Biol.; 19: No. 3, 348-361(May 1974).

A model is proposed to describe the manner in which an area of increased radioactivity may be visually detected in the image of an otherwise uniform distribution of radioisotope. It is proposed that the probability of detecting the abnormality is equal to the probability of it being the most intense signal present and of it having an intensity of at least some value, p, greater than the next most intense signal. The model differs from previous ones in that it uses statistics purely to predict those signal intensities which might be present, and not as a test for a difference in intensity. The model was tested against experimental results obtained when sets of display records, showing a test pattern consisting of a uniform distribution of radioisotope on which was superimposed an abnormality consisting of a 2 cm. diameter circular area of activity, were shown to a group of observers. The display consisted of an array of elements on a cathode ray tube. The brightness of each element was one of eight different grey shades, depending upon the counting density associated with the area of the radioisotope distribution represented by the element. The model is shown to give results in reasonable agreement with experiment. (auth)

15577 PROCESS AND APPARATUS FOR VISUALIZING GAMMA RAY IMAGES. Prag, R.; Dierker, J. (to Siemens Aktiengesellschaft). US Patent 3,812,361. 21 May 1974. Filed date 3 Nov 1971. 6p.

A process and a device are described for visualizing gamma ray images that use a semiconducting plate which is provided on both sides with electrode strips extending parallel to each other, the direction of the strips on one side extending at an angle to the direction of strips on the other side. The invention is particularly characterized in that the gamma quanta are changed into electron bundles and are represented upon the semiconducting plate. The electrode strips are connected with a device for core formation which produces representable local signals localizing the electron bundle striking the semiconducting plate. (Official Gazette)

15578 COAXIAL ANODE WIRE FOR GAS RADIATION COUNTERS. Fletcher, J. C.; Kraushaar, W. L. US Patent 3,812,358. 21 May 1974. Filed date 21 Jun 1973. 8p.

A coaxial anode construction for a gas radiation counter is disclosed by which undesirable background ionization interference may be suppressed. The anode comprises an elongated central wire covered with an electrically insulating sleeve. A plurality of longitudinally discontinuous segments of an electrically conductive coating is disposed about the insulating sleeve in coaxial relationship to and along the length of the central wire. In the preferred inventive embodiment, the plurality of conductive coating segments define a so-called veto or rejection anode at each end portion of the central wire and a main or primary charge detecting anode disposed therebetween. Coupling means are connected to each of the segments such that the primary charge detecting anode is connected to detection circuitry in anti-coincidence with the veto anodes. Background radiation detected by either of the veto anodes and the primary charge detecting anode is therefore rejected and the sensitivity of the radiation counter device is increased. (Official Gazette)

15579 INSTRUMENTATION IN NUCLEAR MEDICINE. Arimizu, N. (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo); 22: No. 7, 376-385(Jul 1973). (In Japanese).

Measuring equipment for use in nuclear medicine is classified according to the purpose of use into sample measuring devices, extracorporeal measuring equipment, and data processing equipment. The present circumstances in the exploitation of equipment are described. Subjects for measurement are the emitted γ-rays contained in the blood, urine, and small tissue samples. Liquid scintillation counters, well-type counters, and well-type ionization chambers are used. The extracorporeal measuring apparatus is described with the whole body measuring apparatus (human counter), organic dynamic function measuring apparatus, and scintigram apparatus. It is important to obtain precise results meeting the diagnostic purpose by minimizing the administration of radioisotopes. The scintigram equipment for organs is divided into detector mobile types (scanner) and detector fixed types (scinticamera, etc.). While scintiscanners require several minutes for scintigraphy, scinticameras perform it in a short time. The resolving power, collimator, method of description, and sensitivity of Anger cameras are illustrated. Mentioned as other fixed detectors are autofluoroscilloscopes, image tube type cameras, spark chambers, semiconductor cameras, hybrid scanners, tomographic scintigram apparatus, and positron scintigram apparatus. Data processing equipment for nuclear medicine including data collecting and reproducing apparatus, fixed processing type apparatus, and processing apparatus by programming are discussed. Problematic points in the practicality of each apparatus are presented. (JA)

15580 WHOLE-BODY GAMMA SCANNER. Asahina, K.; Fukuda, T.; Itoh, T.; Manabe, Y. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Toshiba Rebyu; 28: No. 12, 1362-1366(Dec 1973). (In Japanese).

Most of the scintiscanners now widely used in Japan have been restricted to internal organs in their application. Recently, with the development of short-life radioisotopes to accumulate in bones, devices are required for scanning whole-body bones to detect metastatis of cancer in bones. Conventional scanners, being small in scan area and low in scan speed, hardly could obtain a whole-body scintigram. The Toshiba Whole-Body Gamma Scanner has cleared away these demerits; in addition, it has adopted the up-to-date techniques of electronics. Its prominent features are: images reproducible by means of digital cassette tapes, images uniformly quantified, and compactness. (auth)

15581 MEDICAL APPLICATION OF SEMICONDUCTOR RADIATION DETECTOR. Sasaki, Y. (Tokyo Univ.); Ito, M.; Kobayashi, T. Radioisotopes (Tokyo); 22: No. 3, 145-154(Mar 1973). (In Japanese).

The features of the catheter-type semiconductor radiation detector (CASRAD, small β detector) are tabulated. Examples of application of CASRAD to the measurement of the circulatory time, or the blood flow rate, detection of malignant tumor, and local pulmonary function tests are shown. Referred to as the recent progress of CASRAD were the ^{14}C compound measuring machine in vitro and in vivo, the needle type detectors using other p-i-n composition type elementary particles of Si, the p-i-n detector of Si of the Solid State Radiation Company in the USA, and the p-i-n detector of Si of Simtec Company in Canada. The problem in the application of low energy γ-rays such as ^{99m}Tc to nuclear medicine is the effect of scattering rays on the scan image. As long as NaI crystals with a relatively low resolving power are used, it is difficult to measure effectively the γ-ray peak alone by removing scattered rays. The semiconductor radiation detector has an energy resolving power 10 times higher than that of the NaI detector. Therefore, it is possible to obtain an image with a satisfactory space resolving power by preparing an imaging device of scanner and γ-camera to eliminate the effect of scattered rays using the semiconductor detector in the place of NaI. However, a large detector has not yet been obtained. It is necessary to constantly cool the Ge detector in order to lower the noise level. An attempt at applying x-ray fluorescence analysis in vivo has been performed for the past several years, and in particular, it is applied to thyroid scanning. (JA)

15582 TRANSVERSE-SECTION SCANNING DEVICE TO OBTAIN THREE-DIMENSIONAL RADIOISOTOPE IMAGES. Kashio, E. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan); Katsurada, M.; Nanjo, Y.; Tanaka, E.; Iinuma, T. Toshiba Rebyu; 29: No. 2, 130-134(Feb 1974). (In Japanese).

Radioisotope(RI) image measurement using a gamma camera and scintillation scanner is extremely important for diagnosis in nuclear medicine. In order to increase efficiency of diagnoses for brain tumor, etc., the National Institute of Radiological Sciences-

Toshiba study group has developed a tomographic imaging device. Used with the device, a 3-dimensional image, that is a transverse-section scintigram, is obtained by rotating four detectors. In this device the RI image is displayed on an oscilloscope. A picture of the RI image is taken by using a Polaroid camera or 35-mm camera. Image processing can be carried out by a TOSBAC-3400 computer. (auth)

15583 DETECTION THRESHOLD FOR ALPHA-PARTICLES ON THE SOLID-STATE TRACK DETECTOR OF CELLULOID FILMS. Murakami, A. (Saga Univ., Japan). J. Phys. Soc. Jap.; 36: No. 4, 923-928(Apr 1974).

Experimental investigations have been made on track registration properties of α-particles in the solid-state track detector of celluloid film. Celluloid films exposed to α-particles of 4.4 to 2.2 MeV were etched in NaOH(6N) solution at 40°C and 50°C. The upper limits of the critical (threshold) energy for track registration and the maximum registration range of α-particles in the detector were found to be 3.7 to 3.8 MeV and 19 to 21 μm, respectively. (auth)

15584 HISTORICAL ASPECT OF DEVELOPMENT OF RADIATION DETECTORS IN JAPAN. Doke, T. (Waseda Univ., Tokyo); Miura, I. Oyo Butsuri; 43: No. 3, 198-208(Mar 1974). (In Japanese).

A historical review of the development of radiation detectors in Japan for the last four decades is described. The main part of the description consists of a history of detectors used in the field of nuclear physics and atomic energy relations and that in the field of cosmic ray physics and high energy physics. A historical review on G-M counters, scintillation counters, semiconductor detectors, and solid state dosimeters is given. (auth)

15585 NUCLEONICS AND THE INTERKOSMOS PROGRAM. Gilar, O.; Pavlicek, Z. (Research Inst. of Nuclear Instruments, Premysleni, Czech.). Jad. Energ.; 20: No. 4, 128-130(Apr 1974). (In Czech).

The participation of the Czechoslovak nuclear technique in the enterprise of INTERKOSMOS is described. A detailed account of the radiation detectors used in the satellites is given. (auth)

15586 CLINICAL WHOLE BODY COUNTING. Reizenstein, P. Bristol, Eng.; John Wright and Sons Ltd. (1973). 76p.

Developments in whole body counting techniques including counters, error reduction, clinical diagnosis and new research methods such as whole body neutron activation are described. (UK)

15587 LOW-LEVEL BACKGROUND RADIATION MEASUREMENTS UTILIZING A LARGE THIN WALLED PROPORTIONAL COUNTER. Taylor, G. B. (Applied Nucleonics Co., Inc., Los Angeles). pp 151-153 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

Studies of the environment involving background level beta activity can be successfully performed with the large thin-walled proportional counter described without increasing the specific activity of the radiotracer. Unlike conventional beta detection systems, this detector will accommodate very large samples for highly efficient detection. (WHK)

15588 REGISTRATION CHANGES OF DAMAGE TRACKS IN CELLULOSE DERIVATIVES. Casnati, E.; Marchetti, M.; Tommasino, L. (CNEN, Casaccia, Italy). pp 141-150 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

In recent years damage track detectors have found a large variety of applications in fields such as neutron dosimetry, space dosimetry, microanalysis of fissile elements and radiation physics. The registration properties of the organic detectors depend on their morphological and chemical nature, which can be altered by uv and gamma exposures, thermal treatments, etc. The thermal treatment effects on damage track registration properties of the cellulose derivatives were analyzed. Data are presented to show how by simple thermal treatments it is possible to enhance the sensitivity of cellulose acetobutyrate and cellulose triacetate. When similar thermal treatments are applied to cellulose nitrate foils they reduce the bulk etching rate of such materials. (auth)

15589 STUDIES OF SCINTILLATION PULSE CONTOURS FROM LIQUID AROMATIC SOLUTIONS. Berlman, I. B. (Hebrew Univ., Jerusalem). pp 319-326 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Apparatus for accurately recording scintillation pulse contours from liquid solutions when excitation is by means of pulsed UV or ionizing radiations has been developed. This equipment is particularly suited for the following two types of experiments: the development of tailor-made solutions for a specific type of experiment and the study of radiation damage in the nsec time domain. A systematic study of the mechanisms involved in energy transfer has led to the development of solutions with more favorable scintillation characteristics than commercially available solutions. Several of these solutions are well suited for pulse-shape discrimination. Radicals are formed along the track of an ionizing particle and they are probably responsible for static and dynamic quenching. The type of radicals can be varied by changing the type of solvent and employing the same solutes. The lifetime of the quenching species can be studied by varying the type of solute and using the same solvent. Steric hindrance has been found to be effective in reducing the degree of quenching in a scintillation solution. (auth)

Radiation Dosimeters

Refer also to abstracts 15759, 15842, 16536, 17439, 17456, 17508, 17509, 17605, and 17940.

15590 (EUR-5122(Vol.2), pp 843-854) GAS GAIN CHARACTERISTICS OF A TISSUE-EQUIVALENT PROPORTIONAL COUNTER, AND THEIR IMPLICATIONS FOR MEASUREMENTS OF EVENT SIZE DISTRIBUTIONS IN SMALL VOLUMES. Hogeweg, B. (Radiobiological Inst., TNO, Rijswijk, Netherlands). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Analysis of the biological effects induced by different types of ionizing radiation requires knowledge of energy deposition distributions for these radiations. From the "single step" action model as suggested for the loss of reproductive capacity by mammalian cells through the action of high LET particles, it can be concluded that these event size distributions have to be determined for volumes with diameters of the order of 10 to 100 nm. The best method presently available for the measurement of event size distributions is provided by the tissue-equivalent (TE) proportional counters. Studies of the gas gain of a cylindrical counter show normal gas gain behavior all over the sensitive volume down to a gas pressure of 20 torr. This pressure corresponds to a sensitive volume with a diameter of 0.15 μm for a counter with a diameter of 5 mm. The variation in gas gain over the sensitive volume at lower gas pressures can be explained by the extension of the avalanche which at these lower densities tends to spread over a large part of the sensitive volume. The experimental data show that the magnitude of the variations in gas gain at low gas pressures is too large to derive corrections which would allow spectra of energy deposition events to be measured for volumes with dimensions equivalent to less than 0.1 μm tissue. (auth)

15591 (EUR-5122(Vol.2), pp 869-885) EXPERIMENTAL DEVICE FOR DOSIMETRIC STUDIES AT THE NANOMETER LEVEL. Chmelevsky, D.; Parmentier, N.; Le Grand, J. (CEN, Fontenay aux Roses, France). Mar 1974. (In French).

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

An experimental assembly was developed having two enclosures under differential vacuum. In the first the vacuum makes it possible to simulate target thicknesses from 10 to 100 Å by injection of tissue-equivalent gases. In the second the vacuum is sufficient to detect electrons and positive ions using an electron multiplier. The first tests were made with α sources: ^{241}Am, ^{239}Pu, and ^{244}Cm. The purpose is to determine the frequency of events and the fluctuation of the number of ionizations for each α particle trajectory in the target. (tr-auth)

15592 (EUR-5122(Vol.2), pp 887-897) USE OF MULTIWIRE PROPORTIONAL CHAMBERS IN MICRODOSIMETRY. Krueger, E. H. (Univ. Munich); Rimpl, G. R. Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

The operation and possible use of multiwire proportional chambers in microdosimetry are outlined. (WHK)

15593 (EUR-5122(Vol.2), pp 899-915) LET RESPONSE OF SOLID-STATE DETECTORS: A REVIEW. Becker, K. (Oak Ridge National Lab., TN). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

It is shown in a review of the LET response of various solid-state dosimeters such as TLD, RPL, TSEE, and photographic

film that most of them exhibit (as predicted by the model of trap saturation by low-energy delta rays in a cylindrical zone around particle tracks) a more or less pronounced decrease in sensitivity with increasing LET. The relationship between trap density (low LET saturation dose) and relative high LET (alpha particle) efficiency as well as some changes in the TL or TSEE curves can also be explained by this model. There are, however, apparently also some qualitative differences between the effects of low LET and high LET radiation, which indicate semi-permanent structural changes along high-LET particle tracks. It is concluded that both trap saturation and structural damage contribute to varying degrees, depending on lattice characteristics and the nature of the observed effect, to the detector response. (auth)

15594 (EUR-5122(Vol.2), pp 917-923) EXOELECTRON DOSIMETRY WITH COLLAGEN TISSUE. Gehm, U. (Mueller GmbH, Hamburg). Mar 1974. (In German).

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

The band model of exoelectron emission is illustrated and a typical measurement installation for its detection is shown. The cross linking between protofibriles are given schematically. The results of experimental studies on the detection of exoelectrons from ligamentum patellae are reported and discussed. (JSR)

15595 (EUR-5122(Vol.2), pp 925-934) MEASUREMENTS OF THE VARIANCE OF ENERGY DEPOSITION BY MEANS OF EXOELECTRON EMITTING MATERIALS. Ennow, K. R. (National Health Service of Denmark, Copenhagen). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

The application of exoelectron emitting dosimeters has been a matter for discussion at several occasions, e.g., the third symposium on microdosimetry, and there exists now a need for more detailed examinations of the possibility of experimental evidence for this application. The theory by A. M. Kellerer for calculating the variance of energy deposition in gas counters was applied to exoelectron dosimeters in order to obtain more knowledge of the relative importance of the different parts of the total variance. This theoretical analysis showed that the precision of the measurements has to be improved if the variance caused by the uncertainty of the measurements shall vanish compared to the pure variance of energy deposition. An experimental program has been set up for investigations of the possible improvement in the technique of measurements and preliminary results from this program are given. Measurements have been carried out using materials such as LiF, BeO and CsI in gas counters and in high vacuum using a channel electron multiplier as detector. The last system seems to be most promising and although the results so far are rather discouraging much more work has to be done before any conclusion can be drawn. (auth)

15596 (EUR-5122(Vol.2), pp 935-950) THERMOSETTING RADIATION-SENSING GEL FOR SMALL-VOLUME DOSIMETRY. Rosenstein, M. (Bureau of Radiological Health, Rockville, MD); Levine, H.; McLaughlin, W. L. Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Thin-film radiation detection systems using triphenylmethane dye derivatives have been developed previously, and their dosimetric properties have been described in the literature. Until the present work, the solid activator matrix that best sensitized radiolytic dye production was gelatin. Gelatin has the serious problems of dimensional instability and migration of the dye formed after irradiation. The improved activator matrix described has potential wide application as a radiation detector and imaging system. The dosimeter response results from conversion of the dye precursor to the colored dye, and is a nearly linear function of absorbed dose. Due to the nonturbid matrix, image resolution of 1 μm can be achieved using microdensitometry. The most successful formulation of those investigated to date contains: a triphenylmethane dye precursor; a specific combination of monomers and polymers, which constitute the activator matrix; and a polymerization initiator. The thermosetting formulation can be molded into a solid glassy resin. Its elemental constituents are C, H, N, and O, and its mass energy absorption coefficient for photons above 200 keV is within 4 percent of that for water and muscle. Down to at least 25 keV, there is no significant variation of dosimeter response with photon energy. Variation of response with ambient temperature during irradiation of the system, relative to room temperature, is less than $\pm 5\%$ between 0 to 50°C. After irradiation and a slight initial 24-hour color buildup, the image is stable for about 1 month. Then a gradual fading occurs. With a 2 mm-thick gel, absorbed doses of 10 krad can be detected with precision limits of 5 percent. (auth)

15597 (EUR-5122(Vol.2), pp 1015-1025) REVIEW ON W-VALUES. Bichsel, H. (Univ. of Washington, Seattle). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Several recent investigations related to the integral (W) and differential (ω) energy needed for the formation of an ion pair in the gas of an ionization chamber are discussed. The study is directed to the area of neutron dosimetry. (WHK)

15598 (EUR-5122(Vol.2), pp 1027-1042) MICRODOSIMETRY OF MONOENERGETIC NEUTRONS. Rodgers, R. C.; Gross, W. (Columbia Univ., New York). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Microdosimetric event spectra produced by monoenergetic neutrons have been measured using a wall-less tissue equivalent spherical proportional counter. The neutrons ranged in energy from 0.22 to 15 MeV and additional data were obtained for neutron spectra whose maximum energies were 60 and 100 keV. The gas pressure in the counter was varied to obtain data for simulated diameters between 0.5 and 8 μm. The results demonstrate the relative importance of the several processes involved in the deposition of energy by neutrons in this wide energy neutron range without being distorted by any significant wall effects. At low neutron energies the dose is almost entirely delivered at lineal energies between 10 and 150 keV/μm. Fifteen MeV neutrons have significant dose contributions at lineal energies an order of magnitude above and below these values. The dose mean lineal energy rises with increasing neutron energy to a broad peak at about 0.5 MeV. The values then dip to a minimum at about 4.5 MeV. Further increase in the neutron energy again increases dose mean values, the largest value occurring for 15 MeV neutrons. (auth)

15599 (EUR-5122(Vol.2), pp 1055-1069) DOSIMETRY OF HEAVY COSMIC IONS IN THE SPACECRAFT APOLLO XVI-XVII. M 211-Biostack-NASA Experiment. Pfohl, R.; Kaiser, R.; Massue, J. P. (Univ. Strasbourg). Mar 1974. (In French).

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

The M 211-NASA Biostack experiment provided by the European Group of Space Biophysics was carried out during the 16th and 17th Apollo moon missions. The purpose was to gain a better understanding of the risks from heavy ions during long-duration space missions. The registration of the ions was made in Ilford K2 emulsions where the trajectories of the heavy ions are shown by tracks whose structure (granularity, thickness, and attenuation) gives information on the nature and energy of the particles. The calibration of various parameters (among others the relation between the photometric measurements and the ionization) was done with ^{12}C and ^{16}O ions of the Berkeley Bevatron at 250 MeV/nucleon and 2.1 GeV/nucleon. Problems concerning the LET and the spatial distribution of δ rays are considered. The total doses found in the two missions are 3.3 and 3.5 mrad whereas the local doses in a cylinder of 10 μ radius are of the order of 20 rad. The doses due to nuclear stars produced by the interactions of light particles with the emulsion nuclei are also considered. For these interactions the local dose in a sphere of 10 μ radius is 3 rad. (tr-auth)

15600 (SZS-153) FOURTH INTERNATIONAL SYMPOSIUM ON PERSONAL DOSIMETRY, POTSDAM, GERMANY, OCTOBER 10-14, 1972. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Aug 1973. 299 p. (In Several Languages). (CONF-7210120-). Dep. NTIS (US Sales Only) $18.00.

A separate abstract was prepared for each of the 29 papers presented at the conference. (WHK)

For abstracts of individual papers see: 15601-15623, 16536, 17309, 17454, 17508, 17509, and 17605.

15601 (SZS-153, pp 1-18) PROPERTIES OF FILM AND SOLID-STATE PERSONNEL DOSIMETERS FOR MONITORING X- AND GAMMA-RADIATION. Kraus, W.; Will, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Recently several personnel dosimeters for gamma and x-ray measurement were investigated in the National Center for Radiation Protection of the GDR. The most important properties of the following detectors and their capsules are given: photographic film, transmission borosilicate glass, radiophotoluminescent glasses, and thermoluminescent detectors. Capsules and evaluation methods were developed with regard to the special conditions of a centralized monitoring service. (auth)

15602 (SZS-153, pp 19-29) ANALYSIS OF THE USE OF TL DETECTORS APPLIED AT PRESENT IN CENTRAL LABORATORY

FOR RADIOLOGICAL PROTECTION (CLOR). Wolska-Witer, M.; Koczynski, A. (Centralne Lab. Ochrony Radiologicznej, Warsaw). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Since 1967 the accuracy of dose measurements has been examined using various kinds of TL detectors. TL materials such as CaF_2:Mn or LiF as loose powders were used as well as discs of LiF embedded in Teflon, monocrystals of LiF, and discs of extruded LiF. The detectors were used as follows: (1) measurements of low individual exposures. Results of TL detector measurements were compared with those obtained by film badges under the same conditions of use; (2) background measurements (long-time exposures), performed in CLOR, Institute of Oncology and Institute of Nuclear Research, using CaF_2:Mn and LiF detectors; (3) the accidental TL gamma radiation dosimeters were investigated in mixed neutron + photon radiation fields during IAEA experiments; and (4) in international x-ray measurements comparison managed by European Late Effects Project Group (EULEP) for radiobiological purposes. (auth)

15603 (SZS-153, pp 30-39) RTL ALUMINOSPHOSPHATE GLASS AND ITS APPLICATION IN THE NATIONAL PERSONAL DOSIMETRY SERVICE IN THE CSSR. Fejtek, J.; Trousil, J. (Inst. for Research of Radioisotope, Prague); Nernda, J.; Suvau, J. Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The results of the study of the dosimetric properties of aluminophosphate glass are reported. The relation between the RTL response and exposure is expressed analytically up to an exposure of 3000 R. The fading within a few hours to months and the possibility of exposure time determination was studied. The results of examining the reusability of the glasses and the energy dependence are discussed. An overall evaluation of the dosimetric properties of aluminophosphate glasses and of their applicability in personal dosimetry is given in the conclusion. (auth)

15604 (SZS-153, pp 40-50) USEFULNESS OF SINTERED LiF DOSIMETERS FOR ROUTINE LOW DOSE MEASUREMENTS. Niewiadomski, T.; Ryba, E. (Inst. of Nuclear Physics, Krakow). Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The large-scale production of LiF sintered low price dosimeters and their low spurious luminescence provides for their routine application in personnel monitoring and background measurements. Some steps have been taken to eliminate troublesome annealing after each use and to achieve good reproducibility in routine low dose measurements. In a new reader designed for this purpose the dosimeters are heated in three steps, i.e., 140, 235, and 320°C, without any interoperational annealing. The doses are measured by means of total light out-put integration due to the simplicity and reproducibility of this method. The long-term behavior of the dosimeter in different laboratory and wearing conditions was investigated and errors introduced by several agents were estimated. Using pure nitrogen during readout, the dosimeter (discs 4.5 mm in diameter, 0.6 mm thick) background was equal to a dose of 1 mrad ±10% SD. The precision at this dose level in laboratory conditions was also studied. The results of 1 year's experience in personnel monitoring obtained with these dosimeters worn in special plastic holders are also given. (auth)

15605 (SZS-153, pp 51-61) PROBLEMS OF AUTOMATIZATION IN PERSONNEL MONITORING. Herrmann, D.; Kraus, W.; Rothe, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Possibilities of automatization of film and TL dosimetry are compared. This comparison shows, that the premises for complete automatization are more favorable in TL than in film dosimetry. The relation between expense and advantage of automatization is discussed. (auth)

15606 (SZS-153, pp 62-79) EXPERIENCES IN APPLICATION OF SOLID STATE DETECTORS IN PERSONNEL MONITORING. Kraus, W.; Will, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

In addition to photographic film, in the last years modern solid state dosimeters were proved for personnel monitoring of x- and γ-radiation by the National Radiation Protection Center of the GDR. The experiences obtained in testing and practical application of the dosimeters are given. No significant differences in measurement accuracy were found for the several dosimeters. For economical reasons photoluminescent detectors will not be applied in the future. At present several hundred persons are monitored by a double dosimeter consisting of a normal film badge and a two-component LiF/Teflon dosimeter. (auth)

15607 (SZS-153, pp 80-89) FINGER-RING DOSIMETER WITH THERMOLUMINESCENT DETECTOR. Will, W.; Grosse, G. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Starting from the necessity of measuring hand irradiation a finger-ring dosimeter was developed in which LiF embedded in Teflon is used as detector and which is appropriate to measure x-, γ-, and β-radiation. The properties of the dosimeter (measuring range, energy dependence, sensitivity to influences of surroundings etc.) are described and the advantages in comparison to the film dosimeter up to now used are indicated. Finally, practical application of the new finger-ring dosimeter is discussed. (auth)

15608 (SZS-153, pp 90-98) PERSONNEL MONITORING OF EMPLOYEES INHALING RADON DAUGHTERS. Friemert, R. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Individually accumulated exposure by inhalation of radon daughters is evaluated usually by measurement of potential alpha energy and assessment of working time in special areas. This value, however, is often erroneous (unknown real working time, large differences of activity concentration in surroundings of working area). By means of a personnel monitoring system, elimination of some errors is possible. Application of several detector types (film, solid-state track detector, thermoluminescence dosimeter) for individual radon daughter dosimetry is discussed. Finally, results of investigations on the application of $CaSO_4$:Dy and CaF_2:Mn for TL radon dosimetry are presented. (auth)

15609 (SZS-153, pp 99-106) EVALUATION OF BETA DOSE BY PHOTOGRAPHIC METHOD. Wysopolski, J.; Musialowicz, T. (Centralne Lab. Ochrony Radiologicznej, Warsaw). Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The personal monitoring method being in current use in CLOR for estimation of beta doses is described. The method was experimentally proved by irradiation of film dosimeters with beta and mixed beta + gamma radiation. The relative error of dose evaluation does not exceed ±30% in the dose range 0.5 to 12 rads and for maximum energy from 0.6 to 3.5 MeV. For mixed radiation with low maximum beta energy this error was larger. (auth)

15610 (SZS-153, pp 107-116) PROBLEMS IN STANDARDIZATION OF FILM DOSIMETERS FOR X- AND γ-RADIATION. Bruening, L. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The recommendations for standardization of film dosimeters for x- and γ-radiation given from the Council for Mutual Economic Assistance (CMEA) are examined. This standard is the the basis of national standards in CMEA member states. The standard used up to now in the GDR dosen't include the CMEA recommendations. Therefore, it must be revised. The realization of the technical requirements in the CMEA standard by the dosimeter film currently used in GDR was investigated. These investigations showed that the requirements cannot be realized with regard to response constancy at the lower dose limit and dosimeter resistance to aging, because of high fogging of the film. The conclusions of these tests are discussed. (auth)

15611 (SZS-153, pp 143-146) COMPARISON OF PERSONAL NEUTRON DOSIMETERS. Jasiak, J. (Centralne Lab. Ochrony Radiologicznej, Warsaw). Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

A review of recently available methods, techniques and detectors in current use in nuclear establishments for personnel neutron dosimetry is given. The methods are compared with regard to their advantages and disadvantages under normal and accidental conditions. (auth)

15612 (SZS-153, pp 147-153) APPLICATION OF SOLID STATE TRACK DETECTORS FOR ACCIDENTAL AND ROUTINE NEUTRON DOSIMETRY. Doerschel, B. (Technische Univ., Dresden). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The solid state track method represents a technique for neutron

dosimetry using registration of nuclear fissions produced by neutrons. For this purpose, suitable detector foils are covered by layers of fissionable material, producing detectable damages by fission fragments owing to neutron irradiation. The sensitivity of such a neutron dosimeter depends on the thickness of the fission material layer. Dosimeter systems suitable for application in accident and routine dosimetry can be produced by appropriate shape of fissionable material and combination of various nuclides. (auth)

15613 (SZS-153, pp 154-160) TRACK ETCH DETECTORS IN CZECHOSLOVAKIAN NATIONAL PERSONNEL DOSIMETRY SERVICE. Singer, J.; Trousil, J. (Inst. for Research of Radioisotope, Prague). Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Results of the development of track detectors for personnel dosimetry of neutron exposures are given. The work was carried out with cellulose triacetate, polyethylene terephthalate and mica where the fission fragments from natural and enriched uranium were registered. The track counting was accomplished using a microscope and automatic track counting system—spark counter. The results for different neutron sources and neutron fluences are presented and the possibility for practical application in the Czechoslovakian national personnel dosimetry service is discussed. (auth)

15614 (SZS-153, pp 161-165) FISSION TRACK DETECTORS AND THEIR APPLICATION IN NUCLEAR ACCIDENT DOSIMETRY. Jozefowicz, K. (Instytut Badan Jadrowych, Swierk, Poland). Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Fission track detectors, consisting of Makrofol E, polycarbonate foil, and thick fissionable foils of thorium, and natural and depleted uranium, were developed for neutron fluence measurements. Microscopically estimated fission track densities allow a determination of the fission rates for each fissionable material to be made. Applying properly calculated mean cross-section values one can calculate fast, thermal and intermediate neutron fluences, and subsequently convert them into doses. Neutron spectrum shape should be known or assumed. Fission track detectors were included into experimental sets of accident dosimeters and used in intercomparison experiments. The developed set allows a determination of the neutron doses within the limits of: 1 to 4×10^3 rad for fast neutrons; 2 to 1×10^2 rad for intermediate neutrons; and 7×10^{-3} to 70 rad for thermal neutrons. (auth)

15615 (SZS-153, pp 180-194) INVESTIGATION OF DETECTORS FOR USE IN NUCLEAR CRITICALITY ACCIDENT DOSIMETRY. Siwicki, R. (Inst. fuer Kernforschung, Swierk, Poland); Jozefowicz, K. Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

In the frame of an IAEA coordinated research program the experimental detector set has been elaborated and used in two multilaboratory intercomparisons. The radiation sources—CRAC assembly, Valduc, France and HPRR reactor, Oak Ridge, USA—are briefly described. As neutron detectors, the fission track detectors and activation detectors have been used; gamma radiation has been measured using film badges, RPL detectors and TL detectors. The results of measurements are presented in terms of fluences and/or doses, discussed and compared with the results of other participants. The investigated detector set is used during critical experiments at the Institute of Nuclear Research. (auth)

15616 (SZS-153, pp 195-204) CONCEPTION OF AN ACCIDENT DOSIMETER FOR FAST NEUTRONS. Nikodemiva, D.; Hrabovcova, A.; Minarik, F. (Inst. fuer Arbeitshygiene und Berufskrankheiten, Bratislava). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

A dosimeter consisting of three threshold detectors is proposed for assessment of dose equivalent of fast neutrons in case of accident. Detector materials are selected in such a way that energy thresholds cover a range up to 14 MeV. The following threshold reactions are used: $^{32}S(n,p)^{32}P$, $^{27}Al(n,p)^{27}Mg$, $^{27}Al(n,\alpha)^{24}Na$, $^{115}In(n,n')^{115m}In$, and $^{115}In(n,2n)^{114m}In$. The activity of the irradiated detectors, except ^{32}P, was measured by a multichannel analyzer and semiconductor detector. In the literature many publications are found by which the neutron spectrum can be calculated from both known activation and cross sections of detectors. However, in most cases these methods are designed only for reactor fission spectra. In accident dosimetry fast processing of results is necessary. For this purpose, so-called "express" methods, Koehler- and Kramer-Agejev-method, were tested. There is less information about measurements in the surroundings of neutron generators and accelerators. In such cases the Di Cola method is used. Using a suitable weighting function the unknown function of neutron flux density is presented as a linear combination of Legendre polynomials. Results are given for two spectra measured by the described methods. (auth)

15617 (SZS-153, pp 205-212) SYSTEM OF NEUTRON ACCIDENT DOSIMETRY IN THE GDR. Dymke, N.; Herrmann, D.; Kraus, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The neutron accident dosimeter developed by Technical University Dresden under contract with the National Center for Radiation Protection of the GDR is presented. The dosimeter consists of a set of activation detectors and of a combination of fission-foil solid-state track detectors. The following topics are discussed: kinds of institutions in which accident dosimeters must be applied, number of dosimeters needed in GDR, centralized or decentralized evaluation, and mode of assuring permanent readiness for service. (auth)

15618 (SZS-153, pp 213-225) NEUTRON ACCIDENT DOSIMETRY BY MEANS OF ACTIVATION SYSTEMS. Schmitt, W. (Zentralinstitut fuer Kernforschung, Dresden). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The neutron accident dosimeter system developed for the National Center for Radiation Protection of the GDR is described. It consists of a neutron accident badge (Au, Au + Cd, Cu + Cd, In + Cd, S, solid state track system, LiF–Teflon dosimeter), button-dosimeters (Cu, Cu + Cd, S), stationary dosimeter (Au or LiF moderator sphere detector, neutron accident badge, Zn, Fe and Al threshold detectors) and activation of hair and blood. (auth)

15619 (SZS-153, pp 228-233) METHODS OF TRANSFER OF THE DOSIMETRIC UNITS IN THE FIELD OF RADIATION PROTECTION. Korn, H. (Deutsches Amt fuer Messwesen und Warenpruefung, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The special methods in transfer of dosimetric units to the user of radiation protection measuring instruments are reviewed. The realization of units of exposure (x- and gamma radiation) and of absorbed dose (beta radiation) as well as the secondary standards used for transfer in the field of radiation protection are briefly discussed. The units are transferred by confirmation of dosimetric normals, by calibration or special tests of practically used dosimeters and by irradiation of calibration films with defined doses. (auth)

15620 (SZS-153, pp 234-238) ORGANIZATIONAL PRINCIPLES OF PERSONNEL MONITORING. Shamov, V. P.; Liberman, A. N. (Inst. fuer Strahlenhygiene, Leningrad). Aug 1973. (In Russian).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The general principles of the personnel monitoring system for occupational exposure with x- and gamma radiation in the USSR are discussed. To establish a uniform extent and counts of personnel monitoring, a classification of radiation sources according to the radiation hazard of personnel is proposed. The most important radiation studies are classified and the resulting conclusion for personnel monitoring are discussed. (auth)

15621 (SZS-153, pp 265-273) STUDIES ON RADIATION PROTECTION MONITORING OF PARTIAL BODY IRRADIATION AT ROUTINE OPERATIONS IN RADIOCHEMICAL ESTABLISHMENTS. Ringel, V.; Schnorrbusch, H. (Zentralinstitut fuer Kernforschung, Dresden). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

External partial body exposure was studied at special research and routine operations in ZfK Rossendorf to prove the conception of radiation protection monitoring. It was attempted to predetermine the necessity for individual monitoring during typical operations according to the criteria recommended by ICRP. Partial body irradiation depends on local and time dependence of the radiation field, special behavior of the operator at the working place, and frequency of working processes. Therefore, appraisals of partial body exposures from area monitoring represent only upper limits of exposure. By comparison of the predetermined "exposure product" (partial body exposure per working process multiplied by the frequency of working processes per monitoring period) with an investigation level it is possible to plan adequate monitoring during operations. For instance, finger ring dosim-

eters must be used, if hand exposure can exceed 900 mrem in two weeks. For routine operations the "exposure product" can be assessed by survey measurements, which were carried out by thermoluminescence dosimeters. (auth)

15622 (SZS-153, pp 274-283) REGISTRATION OF EXTERNAL OCCUPATIONAL RADIATION EXPOSURE IN THE GDR 1963 TO 1970: RESULTS, PROBLEMS, AND PERSPECTIVES. Koenig, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Results of the centralized film badge service in the GDR in 1963 through 1970 are given. Individual doses are correlated with kind of institution, work, profession, radiation quality, time of exposure and age of occupationally exposed person. Deriving from a discussion of the results obtained, the performance of film dosimetry in the GDR is critically evaluated. Future possibilities concerning detector systems and organization of external occupational radiation monitoring in the GDR are outlined. (auth)

15623 (SZS-153, pp 284-289) SOME REMARKS ON OVER-EXPOSURES RECORDED IN 1970 AND 1971 IN THE GDR. Rothe, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The over-exposures assessed by means of film dosimeters are analyzed. By definition over-exposures exceed 400 Mrad per month measured by the central monitoring of occupationally exposed persons. The studies are aimed at evaluating the existing possibilities of ascertaining the occurrence of such over-exposures. It is remarkable that the film blackening pattern is suitable for this, particularly in case of higher exposures. Moreover, from the frequency of over-exposures in some few establishments conclusions on the monitoring intervals can be drawn. (auth)

15624 HIGH-SENSITIVITY ENVIRONMENTAL DOSIMETRY SYSTEM UTILIZING $CaSO_4$(Tm)TLDs. Bronson, F. L.; Sha, R. C. M. (Radiation Management Corp., Philadelphia). Trans. Amer. Nucl. Soc.; 18: 51-52(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15625 SPARK COUNTING OF NEUTRON-INDUCED RECOIL PARTICLE TRACKS IN POLYMERS. Becker, K.; Abd-elRazek, A. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 83-84(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15626 USE OF A DIRECT READING SOLID STATE DOSIMETER IN RADIATION THERAPY. Benary, V. (Tel Aviv Univ., Israel); Friedland, S. S.; Schlesinger, T.; Werner, A. pp 687-696 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

A small plane parallel lithium-drifted silicon p-i-n junction dosimeter mounted in a 3 mm diameter stainless steel tube with a 4 mil wall thickness was used as an in vivo dosimeter to find the dose in the rectum after insertion of ^{137}Cs needles for cervix therapy. The advantages of the solid state detector are discussed, and the calibration procedure is outlined. (WHK)

15627 SIMPLE DESIGN CONSIDERATION FOR TL AND TSEE SAMPLE HEATERS. Nash, A. E. (Naval Research Lab., Washington, DC). Health Phys.; 27: No. 1, 129-130(Jul 1974).

Failures after only 10 to 15 heat cycles when using a sample temperature of 500°C have led to a modification of the inexpensive automatic cigar lighters which may be used as the basis for low-cost sample heaters for thermoluminescence or exoelectron dosimeter readers (Attix, Int. J. Appl. Radiat. Isotop.; 22: 185 (1971)), which overcomes this drawback. The solution consists of: (1) disconnecting the outside spot-weld of the heater spiral and release coil tension. This provides several thousandths of an inch clearance between adjacent turns. Reweld end of heater coil to complete the circuit; (2) preparation of a thin solution of a refractory cement, fill spaces between coil windings and cure the cement; and (3) initial heating of the coil with electrical current should proceed slowly to avoid coil distortion. Complete the curing process by raising voltage and current to the desired value and hold at maximum temperature for several minutes. Such an improved heater will yield in excess of 500 cycles to 400 and 500°C before failure. (UK)

15628 RADIATION DETECTOR AND PROCESS UTILIZING SAME. Chandross, E. A.; Salmon, W. A. (to Bell Telephone Labs., Inc.). US Patent 3,808,443. 30 Apr 1974. Filed date 30 May 1972. 8p.

A photodimer, preferably derived from an anthracene derivative, serves as a radiation detector. Irradiation, e.g., electron radiation, brings about dissociation to the broken dimer (or monomer) state. The dissociated dimer fluoresces when illuminated by ultraviolet light. Included as a marking on PVC insulated wire destined for irradiation crosslinking, it serves as a production control. (Official Gazette)

15629 AUTOMATIC THERMOLUMINESCENCE DOSIMETRIC SYSTEM WITH CODED CARD. Szalanczy, A.; Shrader, E. F.; Shoffner, B. M.; Chamberlain, J. D. (to Kewanee Oil Co.). US Patent 3,809,901. 7 May 1974. Filed date 30 Nov 1971. 10p.

A precision machine is provided which automatically senses the thermoluminescence emanating from a dosimeter which has previously been exposed to radiation, particularly x-rays, gamma rays, electrons and neutrons, wherein the dosimeters are mounted in uniform, rectangular cards adapted to be stacked in a cartridge. The cartridge is horizontally disposed near the top of the machine. A single card is selectively transferred from the cartridge into a vertical gate with a plurality of sequential light locks. Each card is automatically positioned for activation of the dosimeter by contact with a cyclically heated, hot element. After a reading of disseminated luminescence has been made, the cards are automatically discharged from the vertical chute into a receiver where they are serially stacked in another cartridge. Readings with less than 1 percent error can be made reproducibly. (WHK)

15630 KALORIMETRIYA IZLUCHENII YADERNOGO REAKTORA. (Calorimetry of Radiation From a Nuclear Reactor). Kolyada, V. M.; Karasev, V. S. Moscow; Atomizdat (1974). 184p.

This book deals with experimental techniques used in measuring radiations from a nuclear reactor by calorimetry. The first two chapters discuss neutron and gamma interactions with matter, especially with regard to absorbed energy. The third chapter deals with general problems of calorimetry such as heat exchange and temperature measurement. Chapter 4 discusses adiabatic, kinetic and isothermal methods of reactor calorimetry. Calorimetric dosimetry of gamma and neutron radiation is covered in chapter 5. The application of calorimetric methods to reactor operation is discussed in chapter 6, and the radiation heating of materials in nuclear reactors is presented in chapter 7. (SJR)

15631 IMPROVEMENTS IN OR RELATING TO RADIATION DOSEMETERS. Brunskill, R. T.; Langmead, W. A. (to United Kingdom Atomic Energy Authority). British Patent 1,340,513. 12 Dec 1973. Filed date 6 Nov 1970. 3p.

The dosemeter described comprises thermoluminescent powder mounted on both faces of a base material that can be rf heated. Graphite is considered to be the most suitable base material on account of its closeness to tissue equivalence; other possible base materials include certain Al-base alloys. A preferred thermoluminescent powder is Mn-doped lithium borate, which has good tissue equivalence and can be re-used immediately after heating; other thermoluminescent powders may also be used, for example LiF. Circulation of N_2 through the dosemeter during heating and read-out improves accuracy of dose measurements. With thermoluminescent powder on both faces of the base a dosemeter may be made so that one side is exposed to both β- and γ-radiation and the other side is shielded by the base so that β-radiation is cut off; thus allowing the concurrent measurement of both types of radiation. A suitable read-out apparatus is described. The thermoluminescent powder may be fixed on the base material by a silicone resin able to withstand transient temperatures of up to 350°C and which is non-luminous. The holder provided for the base may be of a synthetic plastic material, such as PTFE. A Tufnol outer container may also be provided. (UK)

15632 EXOELECTRON AND ITS APPLICATION TO DOSIMETRY. Okabe, S. (Radiation Center of Osaka Prefecture). Radioisotopes (Tokyo); 22: No. 10, 583-592(Oct 1973). (In Japanese).

Some typical features of exoelectron emission exist in the conditions for its generation, its decrease after ceasing irradiation or machining, glow peak in thermally stimulated exoelectron emission (TSEE), and the relation between TSEE and thermally stimulated light or current. There are many substances which emit exoelectrons in nature, but they are subject to some limitations in the use for practical dosimeters. Problems to be noticed as dosimeters are the effects of radiation quality and energy, the effect of atmosphere during irradiation, measurable range, and fading. The optically stimulated exoelectron emission (OSEE) dosimeter has four advantages including its low cost and appears promising. The exoelectron dosimeter appears to be useful in the future because of the advantages of its wide range of measurement, capability of measuring low dose, suitability to practical

high dose measurement, and ability to measure low energy but high dose. (JA)

15633 PREPARATION OF RADIOPHOTOLUMINESCENT DOSIMETER FOR X AND GAMMA DOSE MEASUREMENTS. Wolska-Witer, M. (Centralne Laboratorium Ochrony Radiologicznej, Warsaw); Koczynski, A.; Janicki, J. Nukleonika; 19: No. 4, 355-363(1974). (In Polish).

Basing on elaborated technology of silver doped phosphate glasses the radiophotoluminescent dosimeters have been made suitable for x and gamma radiation measurements for the energies above 60 keV. The dose range is 0.1 to 3000 rads with the accuracy of ±10%. The construction and parameters of these dosimeters are given. The following properties of the described glasses are given and compared to those of Toshiba produced glasses: absorption spectra in the range of uv light; fluorescence emission spectra; and kinds of impurities determined by the way of spectral analysis. (auth)

15634 POSSIBLE DREAM (OPERATIONAL MONITORING, A CONTINUING CHALLENGE). Horan, J. R. (International Radiation Protection Association, Idaho Falls, ID). pp 3-14 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The past, present, and future role of operational radiation protection is critically examined with emphasis on common problems. (WHK)

15635 INTERNATIONAL INTERCOMPARISON OF CHEMICAL DOSIMETERS FOR IN-PILE USE. Marketos, D. G. (Nuclear Research Center Democritos, Athens); Boyd, A. W.; Bod, L.; Draganic, I.; Gal, O.; Gehringer, P.; Humpherys, K. C.; Mantaka-Marketos, A.; Panta, P.; Proksch, E.; Rakintzis, N. T.; Wickham, A. J. pp 98-121 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Eight chemical dosimeters, representing seven different chemical systems, two in gaseous, three in liquid and two in solid form, and two radiochromic films were used for the determination of the absorbed dose due to the mixed radiation (γ-rays, thermal and fast neutrons) in two different irradiation positions of the GRR-1. Three graphite calorimeters were also used for calibration. The thermal and fast neutron flux intensities in the above-mentioned two irradiation positions were determined. The intercomparison was performed under identical irradiation conditions for all samples. A very satisfactory agreement was found between the values from the calorimetric measurements. The comparison of the results of the chemical dosimeters appeared to be very complex due to the different contributions of the fast neutrons and of the γ-rays in some of the systems, and also due to the different response of the same system to these two types of radiation in some cases. Comparison of the results between the chemical dosimetry measurements and the calorimetric measurements shows (a) that the chemical dosimeters containing no hydrogen (the fluorocarbon and the (^{14}CO-$^{13}CO_2$) systems) or small amounts of hydrogen (the H_2S system), the solid oxalic acid system and the two radiochromic dosimeters are more reliable for the determination of the γ-ray dose rate in a reactor within an uncertainty of 5%, and (b) that further studies of the cyclohexane and oxalic acid dosimetry systems are desirable. (67 references) (auth)

15636 USE OF RADIOCHROMIC DYE SYSTEMS FOR DOSIMETRY. Hjortenberg, P. E. (Danish Atomic Energy Commission, Roskilde); McLaughlin, W. L. pp 122-140 of Proceedings of the Regional Conference of Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Radiochromic dye systems have been developed at the U. S. National Bureau of Standards and have been further investigated at the Accelerator Department, The Danish Atomic Energy Commission Research Establishment Riso. Measurable absorbed doses range from 10^2 to 10^8 rads, depending on the particular system. Some characteristic properties are as follows: long shelf life, dose rate independence, low atomic number constituents (C, H, N, O), small temperature dependence, sensitivity to ultraviolet light, linear dose response, rather insensitive to organic impurities. A liquid system with a useful dose range of 10^2–10^5 rads is described. Results demonstrate its capabilities for calibration of radiation fields including isotope irradiators and electron accelerators. Intercomparisons were made with Fricke- and thermoluminescence dosimetry. (auth)

15637 INTERCOMPARISON OF PERSONNEL MONITORING SYSTEMS. Landauer, R. S. Jr. (R. S. Landauer, Jr. and Co., Glenwood, Ill.). pp 187-193 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Personnel monitoring systems were compared on the basis of the following categories: (1) information available, (2) precision, (3) reliability, (4) acceptability, (5) credibility, and (6) cost. The results should aid the health physicist in choosing which system or combination of systems to use in establishing or revamping a personnel monitoring program. (auth)

15638 INFLUENCE OF AMBIENT HUMIDITY ON TL-DOSIMETERS FOR PERSONNEL MONITORING. Christensen, P.; Botter-Jensen, L.; Majborn, B. (Danish Atomic Energy Commission, Roskilde). pp 194-206 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The experiments were carried out with the dosimeters kept in air at different humidities and temperatures and the effects were studied over a period of three months. The dosimeters investigated included LiF, $Li_2B_4O_7$: Mn and $CaSO_4$: Dy in the form of powder as well as solid dosimeters. For comparison film dosimeters were included too. The properties studied comprised hygroscopicity of the dosimeters, fading of the TL-signal and introduction of non-radiation induced TL-contributions. Furthermore, data were obtained from experiments attempting to decrease the hygroscopic nature of $Li_2B_4O_7$: Mn by adding varying amounts of silicon to the material in the dosimeter preparation. On the basis of the experimental results it is concluded that variations in ambient humidity are only of minor importance in the application of TLD for personnel monitoring. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 16887.

15639 (AREAEE-177) POWER SUPPLY FOR HELMHOLTZ COILS. Hanna, N. N. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 21p. Dep. NTIS (US Sales Only) $4.25.

A regulated power supply suitable for driving the Helmholtz coils used to neutralize the vertical and horizontal components of the earth magnetic field in an iron-free beta-ray spectrometer is described. The supply delivers an adjustable voltage in the range 20 to 40 V at a maximum load current of 5A. Over the whole voltage range, the output voltage stability is better 0.03% for ±10% variations in mains voltage. The output resistance is less than 0.005 ohms and the temperature coefficients is about +2 mV/°C at room temperature. (WHK)

15640 (CONF-721018-(Vol.3), pp 812-827) IN SITU ANALYSIS OF SHIELDED, GAMMA-ACTIVE MATERIAL USING A Ge(Li) SPECTROMETER. Spiers, E. W.; Lakey, J. R. A. (Royal Naval Coll., Greenwich, Eng.). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The full energy absorption peak efficiency of a Ge(Li) detector was experimentally determined and mathematically formulated as a function of source position and gamma energy, thus allowing the calculation of detector efficiency for an extended source of known dimensions. The technique is applied to the measurement of a uniform cylindrical source inside a steel tube, such as occurs when corrosion products are deposited on the inside walls of reactor coolant pipes. Test measurements made on a simulated cylindrical source of known specific activity gave results of better than 20% accuracy. (auth)

15641 (CONF-730804-P4, pp 2872-2877) NEW MAGNETIC SPECTROMETER SYSTEM FOR COSMIC-RAY STUDIES. Golden, R. L.; Badhwar, G. D.; Deney, C. L.; Lacy, J. L. (Univ. of Houston, TX). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The balloon flight prototype of a cosmic ray superconducting magnet experiment designed for operation on the Space Shuttle is described. The physical and operating parameters of the scintillation, Cherenkov, emulsion and multiwire proportional counters used in the system for charge and rigidity measurements is given as well as the on-board data handling procedures. (auth)

15642 (CONF-730804-P4, pp 2883-2888) CHARGED-PARTICLE TELESCOPE FOR STUDYING THE FLUX OF PRIMARY COSMIC-RAY NUCLEI AS FUNCTIONS OF CHARGE, MASS, AND ENERGY. Dev Verma, S.; Herzo, D. (Louisiana State Univ., Baton Rouge). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

An experiment has been designed and built to measure the energy spectra and charges of primary cosmic ray nuclei in the energy range from 100 to 3000 MeV per nucleon and to determine the isotopic composition of H, He, Li, and Be in the energy range from 100 to 300 MeV per nucleon. The apparatus is essentially a charged particle telescope in which dE/dx and the total energy of each stopping particle is measured. The apparatus was flown in the summer of 1972, at an altitude of 3 g/cm^2 using a balloon launched from Ft. Churchill, Canada. The apparatus was calibrated by exposing it to monoenergetic beams of ^{16}O ions with energies of 500 to 2100 MeV per nucleon at the Berkeley Bevatron. The total fragmentation cross sections of ^{16}O ions in CsI(Tl) have been measured. Analysis of this calibration and fragmentation data is presented. (auth)

15643 (CONF-730804-P4, pp 2964-2967) MUON SPECTROMETER USING A SUPERCONDUCTING MAGNET. Carstensen, K.; Dau, W. D.; Grupen, C.; Krolzig, A. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The characteristics of a muon spectrograph using a superconducting magnet are presented. The instrument is designed for the measurement of muon spectra at two different zenith angles. It can be adjusted in the vertical direction as well as in the close-to-horizintal direction. Its large angular acceptance (±30°) allows a determination of the muon flux at various inclinations. The spectrograph incorporates a superconducting magnet which produces a field of 2.2 Tesla in a volume of ~1.5 m^3. The muons are recorded in wire spark chambers with capacitive readout systems. The spark positions are stored automatically and the data are transferred to magnetic tape. The m.d.m. of the instrument amounts to ~200 GeV/c, its collection power is 479 cm^{2}sr. (auth)

15644 (COO-2231-12) NEUTRON SPECTROMETRY FROM 200 MeV TO 1 GeV. Madey, R.; Waterman, F. M. (Kent State Univ., Ohio (USA). Dept. of Physics). 1974. Contract AT(11-1)-2231. 14p. (CONF-730470-2). Dep. NTIS $4.00.

From meeting on the American Physical Society; Washington, District of Columbia, USA (23 Apr 1973).

The operation and performance of a neutron spectrometer based on the time-of-flight of elastically scattered neutrons from one scintillator to another are described. A telescope counter detects the recoil proton in coincidence with the scattered neutron. To be accepted a four-fold coincidence is required. (WHK)

15645 (EUR-5122(Vol.2), pp 1043-1053) MEASUREMENT OF FAST NEUTRON SPECTRA WITH A PROTON RECOIL SPECTROMETER. Borst, H.; Coppola, M.; Booz, J. (EURATOM, Ispra, Italy). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Measurements of fast neutron energy spectra have been performed using a proton recoil gas telescope counter. The method for obtaining direct information of the neutron energy spectrum from the integral proton recoil distribution consisted of detecting only recoils around the zero direction, owing to the unique relation existing between energy and direction of particles in a two-body interaction. In order to perform the required selection and, in addition, to reduce the number of spurious events, a technique was developed which combines in a simple manner the main advantages of a multi-section gas telescope counter and of a pulse rise-time discrimination system. Measurements of neutron energy spectra from the Ispra 3-MV Van de Graaff generator were done between 0.8 and 6.0 MeV, showing the ability of this instrument to work under a continuous neutron flux. (auth)

15646 PASSIVE LEACHED HULL MONITOR. Gozani, T. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 193-194(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15647 HEAT PRODUCTION MEASUREMENT IN ROCKS USING A GAMMA RAY SPECTROMETER WITH A SOLID STATE DETECTOR. Lewis, T. (Dept. of Energy, Mines, and Resources Ottawa). Can. J. Earth Sci.; 11: No. 4, 526-532(Apr 1974).

A gamma-ray spectrometer with a solid state detector is described for routine laboratory measurement of U, Th, and K in rocks. The results are used to determine their average rate of heat production. The liquid-nitrogen cooled Ge(Li) detector is used in preference to the conventional NaI detector, even though its counting efficiency is much lower, because its much better resolution permits the isolation of low energy peaks. Using the spectrum obtained over the larger energy range, concentrations can be determined to the same accuracy as with the NaI detector in comparable times. Two analysis techniques were used: the first compares the sample's entire spectrum to those from standards. The alternative technique compares only the sharply resolved peaks measured above the continuum: the counting efficiency is reduced but the sample density can vary as long as a self-absorption correction is made. The results on four United States Geological Survey standard rocks are given. With such a system having a high resolution, the U concentration can be measured using the 63 keV gamma-rays produced in the decay of ^{234}Th to ^{234}Pa, thus indicating whether or not the U series is in equilibrium. (auth)

15648 NEW ELECTRON SPECTROMETER DESIGN. Allen, J. D. Jr. Knoxville, TN; Univ. of Tennessee (1973). 132p. University Microfilms Order No. 74-11,227.

Thesis (Ph.D.).

A new design for a low energy electron analyzer suitable for use as a photoelectron spectrometer and characterized by great mechanical and operational simplicity is proposed. Two identical circular end plates of radius A and an intervening negatively charged cylindrical reflecting electrode of radius A and length C define the analyzer's geometry. The end plates carry annular entrance and exit slits which communicate with the sample volume and electron detector respectively. The development of a computer raytrace program suited to the study of the analyzer is discussed. The program and the bulk of the data accumulated during an extended investigation of the analyzer are tabulated. A number of quantitative assessments of the analyzer's behavior are discussed together with some qualitative remarks concerning the very important focusing characteristics of the analyzer. Results of the computer work indicate that the proposed analyzer is capable of quite exceptional performance when fully optimized. A resolving power as high as 750 is suggested concommitantly with quite high sensitivity. Preliminary experimental results in the form of photoelectron spectra of several common gases (Ar^+, N_2^+, O_2^+, H_2^+) are presented which demonstrate close agreement with the behavior predicted on the basis of the raytrace program data. These results are particularly impressive as they were obtained from an early version of the proposed analyzer the design parameters for which had of necessity been derived from the first (and as it happened, most unfavorable) raytrace data. (Diss. Abstr. Int., B)

15649 PROPOSAL FOR A NEW TYPE OF ALPHA-BETA-GAMMA SCINTILLATION SPECTROMETER. Kalish, Y. (Beilinson Medical Center, Petah Tikva, Israel). pp 312-318 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

A proposal for a new type of spectrometer for measuring radioactivity of samples which emit alpha, beta, and gamma radiations is described. The spectrometer consists of two cylindrical NaI(Tl) crystals, each of which has a semi-cylindrical cavity perpendicular to its major axis in which the vials containing the radioactive samples are placed. Samples containing alpha emitters and beta emitters are dissolved in a liquid scintillator and placed in the cavity. The advantages of the proposed spectrometer as compared with existing systems are discussed. (WHK)

High Energy Physics Instrumentation

Refer also to abstracts 16565, 16683, 16717, 16718, 16739, 16743, 17114, 17372, and 17373.

15650 (ANL-8080, pp 20.1-20.6) GENERAL PURPOSE IMAGE PROCESSING AND ITS DEBT TO HIGH ENERGY PHYSICS. Hodges, D. (Argonne National Lab., IL). 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

The automation of image processing equipment for high-energy physics bubble chamber film scanning and measuring at ANL is reviewed. The uses of the ALICE system at ANL for non high-energy physics applications are outlined. (WHK)

15651 (CERN-74-9(Vol. 2)) MEETING ON TECHNOLOGY ARISING FROM HIGH-ENERGY PHYSICS, CERN, GENEVA,

24–26 APRIL 1974. Proceedings, Vol. 2. Technology Notes. (European Organization for Nuclear Research, Geneva (Switzerland)). 24 Apr 1974. 643p. (CONF-740449-P2).

The 2nd volume contains all 255 Technology Notes, which originally were used as brief documentation handed out at the individual exhibit stands during this Meeting. These Technology Notes contain information on why a particular object was needed, how it was designed, built or developed, what were the special problems, which firms were involved, and who may be contacted for further information. They are grouped under the following categories: General and large installations; Beams and radiation; Cryogenics and superconductivity; Data processing; Electronics; Magnets and electricity; Photography and optics; Vacuum; and Workshop techniques and general engineering. (auth)

15652 (CONF-730804-P3, pp 1962-1970) MUTRON PROJECT I. Kitamura, T. (Tokyo Univ.); Mitsui, K.; Miyake, S. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The design and performance of a new muon spectrometer, MUTRON, consisting of a magnet spectrograph and a calorimeter, for measurements of energies of muons beyond 10 Tev, are described. (CES)

15653 (CONF-730804-P4, pp 2727-2732) ACCELERATOR EVALUATION OF THE PERFORMANCE OF THE COS-B EXPERIMENT FOR GAMMA-RAY ASTRONOMY. Andresen, R. D. (Kamerlingh Ames Lab., Leiden); Arens, I.; Bignami, G. F. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The ESRO satellite COS-B will carry a gamma-ray astronomy experiment featuring a spark chamber and a caesium-iodide energy calorimeter. The response of the instrument has been studied using tagged photon beams of energy between 20 MeV and 6 GeV and a 20.4 MeV nuclear gamma-ray line. The effective area for confident identification of detected gamma-rays incident parallel to the instrument axis has been measured to be 0.6 cm^2 at 20 MeV, increasing to >60 cm^2 above 150 MeV. The angular resolution achieved with currently available analysis techniques is 8° (1σ confidence) at 70 MeV and <2° above 2 GeV. Worst-case limits on the energy measurement capability are also presented. (auth)

15654 (CONF-730804-P4, pp 2733-2736) CALIBRATION AND DATA ANALYSIS OF THE SAS-II GAMMA RAY TELESCOPE. Hartman, R. C. (Goddard Space Flight Center, Greenbelt, MD); Fichtel, C. E.; Kniffen, D. A.; Thompson, D. J.; Ogelman, H. B.; Tumer, T. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The SAS-II spark chamber gamma ray telescope was launched into a low equatorial orbit on the second Small Astronomy Satellite (SAS) on November 15, 1972. The interpretation of the data obtained on celestial gamma radiation above 30 MeV is dependent on a detailed knowledge of the angular and spectral response of the detector, and a careful analysis of the celestial data according to a consistent set of criteria for the selection of clear gamma ray events. A tagged photon facility has been developed at the NBS 170 MeV Electron Synchrotron for calibration of the SAS-II instrument to empirically determine the detector response. On the basis of gamma ray pair production events obtained during the calibration, very detailed data analysis criteria have been developed to insure the most accurate analysis possible of the celestial data. (auth)

15655 (CONF-730804-P4, pp 2742-2747) SOME PROBLEMS IN MEASURING EAS PARTICLE DENSITY WITH SCINTILLATION DETECTORS. Linsley, J. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A description is given of the system presently used at Volcano Ranch to register the light output of plastic scintillators struck by EAS. Particle densities are measured over a range of 5 decades with an instrumental accuracy of 5 percent. Some factors influencing the design of such systems are briefly discussed, but principal emphasis is on "calibration"; that is, on steps taken to evaluate actual performance in this case. (auth)

15656 (CONF-730804-P4, pp 2748-2753) STUDIES ON WATER CHERENKOV DETECTORS. Blake, P. R.; Francis, A. H.; Nash, W. F. (University Park, Nottingham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Studies, both theoretical and experimental, are being carried out on two water Cherenkov detectors (½ m to 1 m deep). The detectors' responses to EAS particles have been compared. Detailed mechanisms of operation are discussed. (auth)

15657 (CONF-730804-P4, pp 2754-2759) AUTOMATIC ARRAY FOR EAS DETECTION BY CHERENKOV LIGHT. Marangoni, G.; Maringelli, M.; Raspollini, G.; Saavedra, O. (CNR, Turin, Italy). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

An EAS array for Cherenkov light detection, associated with a particle detector, has operated since September 1971 at the Pic du Midi Observatory (2860 masl). The optical and temporal features of the detectors are described. A new data storage into analogical TV magnetic tape and an automatic scanning system have been employed. The main feature of the apparatus as well as the possible extension to other visualizing techniques are described. (auth)

15658 (CONF-730804-P4, pp 2761-2766) GLASS SPARK CHAMBERS FOR SHOWER MEASUREMENTS. Allkofer, O. C.; Dau, W. D.; Grupen, C. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The high multi-track efficiency of glass-spark chambers allows its application as a shower detector. Modules of size $80 \times 85 \times 2$ cm^3 have been constructed for this purpose. A set of 21 chambers interspaced with iron plates of one radiation length thickness was used for the measurement of electron showers. An energy resolution of ±11% at 5.4 GeV could be obtained with this setup. (auth)

15659 (CONF-730804-P4, pp 2767-2772) COSMIC-RAY CASCADES PHOTOGRAPHED IN SCINTILLATOR. Barrowes, S. C.; Huggett, R. W.; Levit, L. B.; Porter, L. G. (Louisiana State Univ., Baton Rouge). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Light produced by nuclear-electromagnetic cascades in plastic scintillator can be photographed, and the resulting images on film used to measure both the energy content of the cascades and also the positions at which the cascades passed through the scintillator. The energy content of a cascade can be measured to 20% and its position determined to ±0.8 cm in each scintillator. Techniques for photographing the cascades and analyzing the film are described. Sample data are presented and discussed. (auth)

15660 (CONF-730804-P4, pp 2774-2779) IONIZATION MEASUREMENT OF COSMIC-RAY PARTICLES BY WIDE-GAP SPARK CHAMBER. Majumdar, D.; Mazumdar, K.; Mundra, J. P.; Sen Chaudhury, P. K. (Presidency College, Calcutta). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The operating conditions under which a wide gap spark chamber can detect ionization of cosmic ray particles are described. Observations were carried out using a sealed spark chamber of sensitive area 25×15.5 cm^2 and an effective gap size of 9.5 cm. Argon at low pressure was used as the filling gas and the high voltage pulse was supplied from a Marx generator. For a streamer pulse of peak value 120 kV it was found that the chamber could work suitably with 100% detection efficiency in the pressure range 60 to 120 torr. Under the above conditions tracks of cosmic ray muons traversing the chamber along the direction of the electric field had prominent structures termed as blobs. The structure density is a function of primary ionization produced by muons. Implications for using large volume wide gap chambers working in such a mode for measurement of ionization of weakly interacting particles are discussed. (auth)

15661 (CONF-730804-P4, pp 2810-2812) APPLICATION OF TRANSITION RADIATION TO THE COSMIC-RAY RESEARCHES. Higashi, S.; Honda, K.; Miono, S.; Ozaki, S.; Takahashi, T. (Osaka Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Parameters for the design of x-ray transition radiation detectors for cosmic ray detection are considered including radiator plate spacing and detector optimization for detecting the x-rays. (WHK)

15662 (CONF-730804-P4, pp 2813-2818) ABSORPTION MEASUREMENTS OF X-RAY TRANSITION RADIATION WITH THIN FOIL. Higashi, S.; Honda, K.; Miono, S.; Ozaki, S.; Takahashi, T. (Osaka Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Results of experiments on transition radiation detectors with the Cornell 10-GeV electron synchrotron beam are given. Multiwire proportional chambers were used for the transition x-ray detection. X-ray spectra and pulse height distributions for Mylar and polyethylene radiators are graphed. (WHK)

15663 (CONF-730804-P4, pp 2819-2829) TRANSITION RADIATION PRODUCED IN THIN PLASTIC FOILS BY 3-15 GeV/c ELECTRONS. Ellsworth, R. (Univ. of Maryland, College Park); MacFall, J.; Yodh, G. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Transition radiation produced from thin plastic foils (0.5 and 1 mil mylar; 0.5, 1, and 2 mil polyethylene) by charged particles with Lorentz factor γ ranging from 6000 to 30,000 has been studied using a sandwich array and a magnet separated array. The experimental results are understood in terms of predictions of TR theory which includes interference effects. (auth)

15664 (CONF-730804-P4, pp 2830-2835) SPECTROMETER FOR IDENTIFICATION OF HADRONS OF ENERGY GREATER THAN 300 GeV. MacFall, J.; Ito, A.; Streitmatter, R. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A particle identifier-spectrometer under construction at a mountain laboratory is described. It consists of an ionization calorimeter and a transition radiation detector formed of a sandwich of foam radiators and multiwire proportional chambers. A Monte Carlo simulation of the response in the cosmic ray beam shows that pions and protons can be well separated at energies exceeding 300 to 400 GeV. (auth)

15665 (CONF-730804-P4, pp 2836-2841) DETECTION OF TRANSITION RADIATION USING NUCLEAR EMULSIONS. Zatsepin, V. I.; Razorenov, I. F.; Miltseva, V. A. (P. N. Lebedev Inst., Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

It is shown that the thick-layer nuclear emulsions may be used to record the transition radiation in the x-ray frequency range by counting slow photoelectrons ($E_e \gtrsim 15$ keV) near the generating particle track. In the electron-sensitive BR-2 nuclear emulsion of 800 micron thickness developed within 10 days after manufacturing, the background of the electrons was 1.9 ± 0.2 in a volume formed with a 50 micron diameter cylinder with axis coinciding with the generating particle track. The transition radiation generated in 540 paper sheets of 80 micron thickness each spaced by 800 microns of air produced 1.6 ± 0.35 slow electrons per single generating particle within the same volume, which is in reasonable agreement with a theoretical estimate. Substitution of mylar for paper must increase the yield up to 3 slow electrons per a single generating particle. The described method may be used for determining the multiply charged particle energy in the range of $\gamma = 10^3$ to 10^4 since the yield $\sim z^2$. (auth)

15666 (CONF-730804-P4, pp 2842-2847) IDENTIFICATION OF >0.5 GeV ELECTRONS ON THE BASIS OF TRANSITION RADIATION. Zatsepin, V. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The yield of transition radiation in the 3 to 30 keV region have been calculated as functions of the relativistic factor γ, of ultrarelativistic particles, and number of layers in mailar-beryllium stacks including the radiation absorption in radiators. The comparison between the calculated and available experimental data has shown an agreement between theory and experiment. The multiple scattering effect is not examined. The calculations are indicative of a possibility to construct a detector for the >0.5 GeV electron isolation from a cosmic ray beam and to measure the multiply charged nuclei energy. (auth)

15667 (CONF-730804-P4, pp 2889-2894) COSMIC-RAY ISOTOPE RESOLUTION OBTAINED USING A NEW CHERENKOV-TOTAL ENERGY TELESCOPE. Webber, W. R.; Lezniak, J. A.; Kish, J. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

In the summer of 1972 a new large area cosmic ray telescope was flown on a balloon at Ft. Churchill. This telescope was designed to study the isotopic composition of $Z \gtrsim 10$ nuclei using a new technique employing a combination of Cherenkov and total energy counters (C×E), as well as simultaneous measurements using a more conventional $dE/dx \times E$ technique. The C×E technique achieves mass resolutions $\lesssim 0.4$ AMU for Si nuclei increasing to ~0.8 AMU for Fe nuclei. The mass resolution using this approach shows considerable scope for improvement and a mass resolution <0.4 AMU for Fe nuclei is easily within reach of present technology. (auth)

15668 (CONF-730804-P4, pp 2895-2900) LARGE AREA MULTIELEMENT TELESCOPE FOR MEASURING THE COSMIC-RAY ISOTOPE COMPOSITION. Fisher, A. J.; Ormes, J. F.; Hagen, F. A. (Goddard Space Flight Center, Greenbelt, MD). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A balloon borne detector with good isotopic resolution and large area is described. With a geometry factor of 3000 cm^2-ster it will have an exposure of 5×10^5 cm^2-ster-sec. The detector consists of an 8 deck multi-wire spark chamber, a Cherenkov detector, and a stack of 15 scintillators. The spark chamber defines the particle trajectory and allows a large opening angle. The detector behaves as a multiple dE/dx Range-Energy detector for $Z \lesssim 12$ and as a Cherenkov range detector for $Z \gtrsim 12$. Monte-Carlo simulations have predicted the mass resolutions to be 0.18 A.M.U. for ^{9}Be (140 MeV/nucleon), and 0.7 A.M.U. for ^{56}Fe (400 MeV/nucleon). Scintillator saturation effects are discussed. (auth)

15669 (CONF-730804-P4, pp 2901-2906) ISOTOPIC ANALYSIS OF GeV HEAVY NUCLEI DIFFERENTIAL SLOWING DOWN. Casse, M.; Goret, P.; Koch, L. (CEN-Saclay-Gif-sur-Yvette, France). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A new method of isotopic analysis of cosmic ray nuclei with energies of the order of 0.7 to 2. GeV/n is proposed. It is best suited for very heavy nuclei (iron group), but can be applied to lighter nuclei at least down to carbon. Recent improvements of the velocity resolution of Cherenkov counters now permit resolving the mass dependence of the slowing down of heavy nuclei in thick absorbers. The set up proposed consists of a thick lead absorber sandwiched between Cherenkov counters for charge and energy measurement before and after the absorber. Such a setup should provide a straightforward measurement of the mass of each incoming nucleus individually. Multiple redundancies should permit eliminating the high rate of nuclear interactions within the apparatus. Preliminary tests of the method, performed with the mid-relativistic heavy ion beam of the Berkeley Bevatron are discussed. (auth)

15670 (CONF-730804-P4, pp 2907-2912) PERFORMANCE OF POWDER CHERENKOV COUNTERS. Linney, A. D. (Danish Research Inst., Lyngby, Denmark); Cantin, M.; Koch, L.; Maubras, Y.; Mestreau, P.; Roussel, D.; Soutoul, A.; Valot, P.; Delseny, M. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The optical and mechanical properties of the recently proposed (1) compressed silica powder Cherenkov counter are summarized together with results of experiments using energetic pion (2) and oxygen (3) beams which directly determined the Cherenkov threshold velocity. Counters with refractive indices between 1.05 and 1.2 have been produced for which a simple relationship exists between the index and the density. The feasibility of using the counter in conjunction with a rigidity analyzing magnet for isotope analysis is demonstrated in an experiment in which the isotopes of beryllium produced in a carbon target by energetic oxygen nuclei are separated at 3.65 GV. (auth)

15671 (CONF-730804-P4, pp 2913-2918) CHARGE AND VELOCITY RESOLUTION OF CHERENKOV COUNTERS IN A BEAM OF ACCELERATED OXYGEN NUCLEI. Valot, P.; Soutoul, A.; Roussel, D.; Mestreau, P.; Maubras, Y.; Linney, A. D. (CEN-Saclay-Gif-sur-Yvette, France). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The response of a sequence of Cherenkov counters to oxygen nuclei with energies ranging between 2.1 GeV/n and 360 MeV/n is presented from the point of view of both velocity and charge resolution and in relation to the possible use of such a configuration for chemical and isotopic analysis of the primary cosmic ray nuclei. (auth)

15672 (CONF-730804-P4, pp 2919-2924) MOMENTUM RESOLUTION OF A LARGE MAGNETIC CLOUD CHAMBER. Stottlemeyer, A. (Univ. of Maryland, College Park); LaPointe, M.; MacFall, J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The performance as a momentum analyzer of a 1m × 1m × ½m expansion cloud chamber in a 5.3 kilogauss field was studied. A 4 m^2 ionization calorimeter produced a trigger when single hadrons of energy greater than 55 GeV traversed the cloud chamber. The maximum detectable momentum was determined to be 23 GeV/c. Distortions due to local turbulence and residual clearing field were found to be the causes of this limitation. The cloud chamber is used to calibrate the ionization calorimeter. (auth)

15673 (CONF-730804-P4, pp 2925-2929) TRANSITION EFFECTS IN A MULTI-MATERIAL CALORIMETER. Baruch, J. F.; Brooke, G.; Kellermann, E. W. (Univ. of Leeds, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Experimental work on electromagnetic cascades in multi-absorber calorimeters using 2- and 4-GeV electron beams has been studied. The results conflict with earlier findings that the transition effect varies strongly with the age of the cascade. It is concluded that the transition effect does not preclude the use of such calorimeters of mixed materials. (auth)

15674 (CONF-730804-P4, pp 2930-2935) INSTRUMENTAL AND ANALYTIC TECHNIQUES FOR SEPARATING PROTONS FROM ELECTRONS IN THE COSMIC-RAY FLUX. Crannell, C. J. (Federal City College, Washington, DC); Jones, W. V.; Kurz, R. J.; Silverberg, R. F.; Viehmann, W. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Techniques are being investigated to aid in distinguishing between electrons and the large background of interacting protons which simulate electron-induced electromagnetic cascades. For cosmic ray primaries, incident on the HECRE ionization spectrometer, statistical criteria are employed to test the cascade curves with the incident energy and starting point as free parameters. The physical significance of the distribution of apparent cascade starting points is being studied using Monte Carlo 100-GeV protons. The proposed use of a CsI detector module (totally-active and high Z) to further discriminate against protons is described. (auth)

15675 (CONF-730804-P4, pp 2968-2973) AMH MAGNETIC SPECTROMETER TELESCOPE. Cantrell, W. G. (Texas A and M Univ., College Station; Duller, N. M.; Green, P. J.; Benbrook, J. R.; Osborne, A. R.; Sheldon, W. R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The magnetic spectrometer telescope operated at Texas A&M University in collaboration with the University of Houston cosmic ray group (the AMH instrument) has been used to measure absolute cosmic ray muon intensities at momenta above 2 GeV/c over a wide range of zenith angles. The instrument consists of two separate solid-iron magnetic bending sections with three wide-gap spark chambers located above, between, and below the magnets. The entire assembly is integrally mounted on large circular "rocker beams" to permit the axis of the spectrometer to be tilted to any zenith angle. The performance of the system is described in terms of several statistical studies of recorded data. (auth)

15676 (CONF-730804-P4, pp 2974-2977) MUTRON PROJECT II. Kitamura, T. (Nagaya Univ., Japan); Mitsui, K.; Muraki, Y.; Okada, A.; Saito, K.; Nakamura, I.; Suda, H. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Mutron is a name given to the project investigating muon physics over a few TeV regions. The apparatus is composed of the magnet spectrometer to measure muon momentum and the calorimeter to observe muon interactions with materials. With a prototype magnet (400 cm × 240 cm × 200 cm), preliminary experiments were carried out to obtain data useful for the next step experiment. Two large size (600 cm × 240 cm × 200 cm) iron magnets are already prepared and full scale experiment is now in progress. Beyond 10 TeV region where the magnet spectrometer becomes uneffective, pair-meter is considered as a useful momentum detector. Including the test result of the pair-meter, preliminary results of proto-type experiments are reported. (WHK)

15677 (CONF-730804-P4, pp 2979-2984) ALIGNMENT OF WIRE SPARK CHAMBERS IN A COSMIC-RAY MAGNETIC SPECTROMETER BY MUONS TRAVERSING THE ZERO-FIELD REGION. Bella, G.; Yeivin, Y. (Tel-Aviv Univ., Ramat Aviv, Israel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic-ray conference. Vol. 4.

A method is proposed to align the wire spark chambers, which are used as the particle detectors in a cosmic-ray muon magnetic spectrometer, by analyzing the trajectories of the muons which traverse the spectrometer through the zero field region. The displacements and rotations of the chambers relative to each other can be determined by least-squares fitting of the trajectories of these muons to straight lines. The accuracy obtained for an arbitrary configuration of 22 chambers and 500 (simulated) trajectories is better than 0.25 mm. (auth)

15678 (CONF-730804-P4, pp 2987-2992) INSTALLATION DESIGNED FOR THE INVESTIGATION OF THE PROPERTIES OF THE SUPERHIGH ENERGY MUONS. Aglamazov, V. A.; Gedevanishvili, L. D.; Robakidze, Z. P.; Sakvarelidze, I. I.; Khazaradze, N. G. (Tbilisi State Univ., USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic-ray conference. Vol. 4.

An original installation designed for the study of the muon energy spectrum for various zenith angles and nuclear interaction of muons with energies $E \geq 10^{12}$ eV is described. The installation presents an 8-layer ionization calorimeter of 9 sq. m area. Ten cm thick iron filters are interlaid between the layers. The neutron counters on the three sides of the calorimeter are set into special paraffin housings. The installation is provided with a Geiger counter hodoscope ensuring a better accuracy of the muon trajectory tracing. A greater effect of registration of muons up to 10^{13} eV is obtained due to the calorimeter's positioning at an angle of 45°. The muon energy is found through the measurement of great ionization bursts caused by decelerating photons, while nuclear interactions are recorded through the coincidence of the neutron counter pulses with the ionization bursts. (auth)

15679 (CONF-730804-P4, pp 2997-2999) CHARACTERISTICS OF FLASH TUBE CHAMBER TRACKS OBSERVED AT LONG TIME DELAYS BEFORE TRIGGERING THE CHAMBER. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic-ray conference. Vol. 4.

A noticeable feature of flash tube chamber photographs of cosmic ray tracks is the occurrence of a significant number of knock on electron flashes associated with muon tracks and also the occurrence of random background flashes in the photographs. Quantitative measurements on these phenomena are described. The chamber used (Ashton et al., 1973) had a sensitive volume comprising 96 layers of flash tubes, alternate layers containing 84 and 85 tubes stacked side by side. The flash tubes were of internal diameter 1.6 cm, external diameter 1.8 cm and were filled with neon to a pressure of 60 cm of mercury. In all, 8,112 tubes were used in the 96 layers. The frequency distribution of the number of background flashes (attributed mainly to radioactivity in the glass) observed in examining incoherent muon tracks photographed at a time delay of 20 μs and 200 μs between the passage of the particle and the application of the high voltage pulse to the chamber. The background nature of the flashes is established by the fact that there is no significant variation with time delay and it is seen that the most probable number of background flashes is 47.5. (WHK)

15680 (CONF-730804-P4, pp 3003-3004) HIGH VOLTAGE PULSER FOR A FLASH TUBE CHAMBER. Ashton, F.; Cooper, D. A.; King, J.; Parvaresh, A.; Saleh, A. J.; Tsuji, K.; Wolfendale, A. W. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A pulse forming network which drives a flash tube chamber of total capacity of 0.087 μF to 8 kV for a period of 10 μs is described. (auth)

15681 (CONF-730804-P4, pp 3017-3022) MULTIWIRE PROPORTIONAL COUNTER SYSTEM FOR HIGH-ENERGY ASTROPHYSICS. Lacy, J. L.; Badhwar, G. D.; Deney, C. L.; Golden, R. L. (Univ. of Houston, TX). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Resolution tests of multiwire proportional counter delay line

readout systems are reported. The system is being developed at NASA/JSC for use in a large balloon borne magnet spectrometer. The system is ultimately intended for use in Space Shuttle missions. Tests of two different types of delay line and associated electronics carried out in minimum ionizing particle beams (accelerator and sea level cosmic ray) are reported. Resolution performance is shown to be strongly dependent on type of gas mixture and in the case of inclined events upon the propagation velocity of the delay line. The resolution performance achieved for magic gas chamber filling (100 μm at normal incidence) is far superior to any other state of the art technique capable of being applied to large geometry factor systems. (auth)

15682 (CONF-730804-P4, pp 3023-3028) PRACTICAL TRACK DETERMINING DEVICE FOR SPACE APPLICATIONS. Funch, O.; Iversen, I. B.; Lund, N.; Rasmussen, I. L.; Rotenberg, M. (Danish Space Research Inst., Lyngby, Denmark). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A flash tube system for a cosmic ray telescope has been built and used as a track definition device for heavy cosmic ray particles. A localization accuracy better than ±2 mm has been obtained. The system can be operated efficiently over a wide range of ionization densities by the introduction of a charge dependent delay between the passage of the particle and the application of the high voltage pulse. Selective suppression of the discharges due to knock-on electrons accompanying the relativistic, multiply charged nuclei has been achieved over two orders of magnitude of ionization density. (auth)

15683 (CONF-730804-P4, pp 3029-3033) MEASUREMENTS OF COSMIC-RAY TRAJECTORIES WITH A PROPORTIONAL COUNTER HODOSCOPE. Parnell, T. A. (Marshall Space Flight Center, Huntsville, AL); Guenther, G. A.; Pollvogt, U. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A 50 × 50 cm, 8-layer multiwire proportional counter hodoscope has been developed for performing trajectory measurements in a large geometrical factor cosmic ray experiment. The hodoscope has a nominal position accuracy of 0.5 cm and a 1° angular accuracy. Data obtained from a balloon exposure shows that tracks of heavy cosmic rays are efficiently recovered from the copious triggers due to secondary electrons through the use of two discriminators on each wire. The spatial distribution of counts produced by secondary electrons from the iron group nuclei are compared with calculations of energy deposition from the secondaries. (auth)

15684 (JINR-P13-7994) METHOD FOR SIMULTANEOUS DETERMINATION OF THE DIRECTION AND ENERGY OF RELATIVISTIC COLLIMATED PARTICLES BY MEANS OF VAVILOV–CHERENKOV RADIATION. Zrelov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

A method is described for the simultaneous determination of the direction and energy of particles by measuring the half-difference and half-sum of the angles at which Vavilov–Cherenkov radiation leaves the plane-parallel radiator. The calculation formulas and estimates of the accuracy are presented. An example is given when this method is used to transport the beam along a given path from particle accelerators. (auth)

15685 (ORO-3065-30) RESOLUTION IMPROVEMENT FOR FLYING SPOT DIGITIZER. Fortney, L. R. (Duke Univ., Durham, N. C. (USA). Dept. of Physics). [nd]. 11p. Dep. NTIS $4.00.

A modification to the standard hit detection electronics, used on most flying spot digitizers, has been developed for the RIPPLE bubble chamber film measurement system. The new electronics has made a dramatic improvement in the ability of RIPPLE to resolve closely spaced tracks. Design features and operational results are presented. (auth)

15686 AUTOMATIC MEASUREMENT OF PHOTOGRAPHIC NEGATIVES FROM HIGH ENERGY PHYSICS EXPERIMENTS. Hallowell, P. J.; Lawes, R. A. (Rutherford High Energy Lab., Chilton, Eng.). pp 108-114 of Software for Control. London; Institution of Electrical Engineers (1973).

From conference on software for control; Warwick, England (17 Jul 1973).

The central computing system at the Rutherford Laboratory consists of an IBM 360/195 computer which supports both batch processing and an extensive on-line system. The on-line system is based upon the use of satellite computers, acting principally as data concentrators, to which are attached the variety of special purpose equipments needed to support a high energy physics research laboratory. The Rutherford Laboratory on-line system is based upon a 360 resident program MAST, developed by the Rutherford Laboratory Systems Group. The application discussed utilizes a Honeywell DDP-516 satellite computer for which a general purpose software interface (DAEDALUS) was developed as part of the project. A tool in high energy physics is the hydrogen bubble chamber, a device that indicates the trajectory of sub-atomic particles by a series of bubbles in liquid hydrogen. Stereo photographs of the tracks left by the particles are taken and then the chamber initialized ready for another set of photographs. A bubble chamber can operate in less than a second (resulting in 3 stereo photos) and an experiment can take many months. Thus, each year 10^6 to 10^8 photographs may have to be accurately measured and reconstructed in space from the stereo views. Such a task would be impossible without the computing complex indicated above and without a precise, high speed measuring machine capable of digitizing photographic negatives. The on-line and real time software, resident in both the central and satellite computers, that has been designed to control the measuring machine and subsequently to handle the large amount of data is described. (auth)

15687 EXPERIMENTS ON MODELS OF THE PERCEPTRON TYPE ADAPTIVE RECOGNITION. Lavrent'ev, V. S. pp 163-174 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

Two types of experiments were considered: experiments of the perceptron class and experiments on the separate development of the perceptron for determining the possibilities of perceptrons with crossed connections with discrimination of track configurations. Experiments were made on program models of experimental systems on the M-20 and the BESM-4. The program for modeling the events in a bubble chamber was used as the model of the external medium. The experiments showed that the perceptron with crossed convections is instructed rapidly (10 to 15 instruction cycles) with a probability of 0.8 to 0.9 of discrimination of signals generated at all areas of the net but with small capability (0.55) of stimulus correlation. With decrease in the size of the particle-entrance window and the range of the beginning of the events for instruction with 5 cross-overs and with correction of errors there is an increase in the discrimination to 100% with the zone of alignment no greater than 0.4 to 0.6 along the coordinates. (tr-auth)

Radiometric Instruments

Refer also to abstracts 15483, 15485, and 15741.

15688 NEUTRON MODERATION SNOWFALL RATEMETER. Powers, C. M. (General Electric Co., San Jose, CA); Woodruff, G. L. Trans. Amer. Nucl. Soc.; 68-69(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15689 ANALYSIS OF A VARIABLE INTENSITY BREMSSTRAHLUNG SOURCE. Dresser, M. M.; Gordon, J. D. (TRW Systems, Redondo Beach, CA). Trans. Amer. Nucl. Soc.; 18: 69(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15690 VERY LOW INTENSITY LOW-ENERGY α, N SOURCES IN INDUSTRIAL GAUGING APPLICATIONS. Kamp, A. J. (Dow Chemical Co., Midland, MI); Ruhl, H. D.; Wetherell, J. E. Trans. Amer. Nucl. Soc.; 18: 95(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15691 ELECTRONICS FOR MEASURING NON-ELECTRIC QUANTITIES. II. Primary Detecting Elements and Measuring Methods. Kautsch, R. Messen und Pruefen: Fachbuchreihe, Volume 9. Bad Woerishofen, Ger.; Holzmann ([nd]). 303p. (In German).

Following a short general characterization of α, β, and γ rays, as well as of the radiactive decay as a static process with half-life, the so-called "gamma barrier" for the level measurement as well as the density measurement due to the absorption or scattering of radiations is briefly described. (GE)

15692 MELTING POINT MEASURING APPARATUS USING ALPHA-PARTICLE ABSORPTION. Nakai, K.; Omori, H.; Goto, E.; Koyama, M. (Inst. of Physical and Chemical Research, Wako, Japan). Rikagaku Kenkyusho Hokoku; 50: No. 1, 39-50(Jan 1974). (In Japanese).

When alpha particles pass through an absorber, they lose energy by excitation and ionization. The amount of alpha absorption changes according to the form of the absorber. A new melting point measuring apparatus for trial based on this principle is

described. The apparatus is designed to measure powdered materials with ±0.5°C accuracy from room temperature to 409.5°C. The results obtained were quite satisfactory. (auth)

15693 THICKNESS MEASUREMENT OF CARBON BRICK BY MULTIPLES BACKSCATTERED GAMMA-RAYS. I. Kato, M.; Sato, O.; Saito, H. (Tokyo Univ.). Seisan Kenkyu; 25: No. 12, 541-544(Dec 1973). (In Japanese)

The method of examining the erosion of wall bricks by ^{60}Co buried in blast furnace linings brings about the problem of radiation exposure and molten iron contamination. As a substitute, a method to measure the thickness of carbon bricks was examined based on the fact that backscattered γ-rays differ in non-eroded bricks and eroded, iron-contained bricks. Multiple backscattered γ-rays were measured with a scintillation detector and a multichannel pulse height analyzer. The γ radiation was collimated to carbon bricks at an angle of 45° from a sealed ^{60}Co source of about 10 mCi and backscattered at the angle of 135°. Taking the distance of the detector to the source over a certain value, the thickness of the bricks can be measured simply by multiple backscattered radiation without the effect of single backscattered γ-rays. Thickness measurement of the bricks of 18 to 20 cm thick seems promising by putting 3.5 cm and 1 cm thick iron plates in front of the source and providing an air gap the same as the plate thickness before the detector. (JA)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

15694 (SLA-74-5148) EFFECTS OF IONIZING RADIATION ON DIFFUSED RESISTORS. Fossum, J. G.; Sander, H. H.; Gerwin, H. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 24p. (CONF-740707-8). Dep. NTIS $4.25.

From annual conference on nuclear and space radiation effects; Fort Collins, Colorado, USA (15 Jul 1974).

A theoretical examination of the effects of ionizing radiation on diffused resistors performed to ascertain the feasibility of their use in hardened dielectrically isolated integrated circuits is described. The two basic effects—conductivity modulation, which is generally insignificant or can easily be rendered so, and photocurrent generation, the consequences of which essentially determine the diffused resistor hardness—are studied. Results indicate that typical diffused resistors are quite invulnerable to ionizing radiation. Design guidelines to achieve optimum hardness are implied. Initial findings of radiation experiments performed on a diffused resistor test chip are reported. When transient leakage dissociated with the resistor structures is accounted for, the results substantiate the primary conclusions of the theoretical study. (auth)

Miscellaneous Instruments

Refer also to abstracts 16241, 17740, and 17948.

15695 (KHFTI-72-45, pp 37-38) PROBE FOR THE STUDY ON SUPERLOW INTENSITY LIGHT FLUX INTERFERENCE. Mazmanishvili, A. S.; Tarasenko, A. S. 1972. (In Russian).

A probe for the interference of ultralow light fluxes was constructed. It consists of two photomultipliers with reflecting foils between them. They are arranged in such a manner that the maximum intensity falls on one side and the minimum intensity on the other. (JSR)

15696 (KHFTI-72-45, pp 68-69) TRANSISTOR HIGH-VOLTAGE RAMP GENERATOR. Kirichenko, V. G.; Skubko, V. A.; Kheifets, M. I. 1972. (In Russian).

A circuit for a transistorized high-voltage ramp generator is presented. A circuit for the coordination of the load and generator is also given. (tr-auth)

15697 (NP-20010) DESIGNING AND TESTING A SETUP WITH MAGNETIZED MIRRORS FOR NEUTRON DEPOLARIZATION MEASUREMENTS IN THE LONG WAVELENGTH RANGE. Kraan, W. H. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Mar 1974. 42p. Dep. NTIS (US Sales Only) $5.25.

The apparatus was developed to provide a supplement into the range of long wavelength neutrons ($\lambda \geq 4$ Å) to the existing setup at the Interuniversitair Reactor Instituut for neutron depolarization measurements. Sensitivity considerations and neutron polarization obtained by mirror reflection are discussed; and preparation and testing of the mirrors, design of the setup, guide field, and mounting and testing the setup are described. (WHK)

15698 (TT-74-50011, pp 315-318) RAPID SYSTEM OF AUTOMATIC PUNCH-TAPE OUTPUT OF INFORMATION FROM THE AI-100-1 ANALYZER. Mazurin, N. F.; Solov'ev, V. P.; Churkin, V. N. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The paper describes the SAPAR-1m system of automatic punch-tape output of information from a "Raduga" (AI-100-1) multichannel amplitude analyzer of pulses in the code of the "Minsk-2" or "Minsk-22" computer. The block diagram of the system includes an AU-100-1 analyzer, a code-conversion and puncher-control circuit, and a PL-80 tape puncher. In contrast to earlier setups, the code-conversion and puncher-control circuit is transistorized, and thus faster and more reliable. The top speed of the SAPAR-1m entirely depends on the top speed of the puncher; with the PL-800 puncher, it attains 12 channels per second. Automatic punching of measurement data, combined with machine processing of amplitude spectra on the "Minsk-22" computer, has almost completely eliminated manual operations from gamma-spectrum processing. (auth)

15699 (Y-1947) ELECTRICAL CONDUCTIVITY MEASUREMENTS OF MOLTEN-SALT FLUXES FROM AN ELECTROSLAG REMELTING PROCESS. Lore, J. D. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 15p. Dep. NTIS $4.00.

A high-temperature electrical conductivity apparatus has been devised to provide conductivity measurements pertinent to an electroslag remelting process in operation at the Oak Ridge Y-12 Plant. Tests were made on two grades of calcium fluoride and segments of electroslag melt material. Components of undesirable feed and melt material with a relatively lower electrical transport potential were identified. (auth)

15700 THERMAL IONIZATION-TYPE LEAK DETECTOR FOR SODIUM VAPOR AND AEROSOL. Reed, W. H.; Bauerle, J. E.; Berkey, E. (Westinghouse Research Labs., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 102-103(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15701 EQUILIBRIUM-MODE HYDROGEN DETECTION BELOW 1 ppM WITH A LIQUID-METAL HYDROGEN METER. Bauerle, J. E.; Reed, W. H.; Berkey, E. (Westinghouse Research Labs., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 103-104(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15702 HIGH-PRECISION SMALL-SAMPLE ASSAY SYSTEM. Gozani, T.; Ingraham, C. N.; Costello, D. G. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 127-129 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15703 HIGH-FREQUENCY INSTRUMENT FOR LIQUID-SODIUM PRESSURE AND TEMPERATURE MEASUREMENTS. Billeter, T. R. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 304-305(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15704 APPLICATION OF AVALANCHE TRIODES IN NUCLEAR-ELECTRONICS CIRCUITS. Gavrilov, L. E. (Inst. of Engineering-Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 6, 1615-1627(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 6, 5-17(1973).

The physical foundations of the operation of avalanche transistors are considered along with their distinguishing features, possibilities, and the most promising fields for their application. Characteristics are given of Soviet and foreign avalanche transistors, as well as practical recommendations on the use of low-power transistors operating in the avalanche mode which are manufactured by industry. The main attention is devoted to circuits for the generation and shaping of pulses having nanosecond lengths, including rectangular- and triangular-pulse generators, staircases, and sawtooth voltage generators, powerful voltage and current pulse generators, etc. Circuits for amplitude and time selection of pulses are given which are designed using avalanche triodes, as well as counting circuits. (90 references) (auth)

15705 SOFTWARE FOR CONTROL. Proceedings of a Conference Held at Warwick, England, July 17-19, 1973. London; Institution of Electrical Engineers (1973). vp.

Separate abstracts were prepared for 5 of the 24 papers presented. (WHK)

For abstracts of individual papers see: 15686, 16568-16570, and 17972.

15706 ISOTOPE-SHIFT ZEEMAN EFFECT SPECTROMETER. Hadeishi, T. (to United States Atomic Energy Commission). US Patent 3,811,778. 21 May 1974. Filed date 28 Feb 1973. 10p.

The apparatus and method employing a beam containing specific Zeeman components for rapidly and accurately detecting the presence of trace amounts of a specific biologically dangerous metal element, such as Hg, that contaminates a host substance, such as food are described. In one embodiment for detecting Hg in fish, the apparatus comprises first means for heating a fish sample containing mercury to 950°C to form a vapor, second means for transmitting a focused light beam through the vapor in the form of light spectra produced from a mercury isotope in a magnetic field parallel to the light spectra, said spectra containing 2537 Å light having specific Zeeman components that are equally scattered and differentially absorbed by the Hg in the vapor, comprising a circularly polarized σ^- monitoring component that is attenuated by absorption by the mercury in the vapor an amount corresponding to the amount of mercury in the sample and a circularly polarized unabsorbed σ^+ reference component, said beam then being transmitted through a circular polarization selector for alternately periodically transmitting the respective components passing through the vapor, and a filter for passing only the 2537 Å from the transmitted light beam to means for detecting said remaining components after the beam is so transmitted, as a measure of the mercury in the sample. In practice, a rotating quarter ($\frac{1}{4}$ λ) plate and a linear polarizer having a 2537 Å filter alternately periodically transmits the respective components to a single photomultiplier for providing a light-weight, portable detector. (Official Gazette)

15707 APPARATUS FOR TESTING OR FOR APPLYING RADIATION TO OBJECTS. Sharples, J. J. E. (to Coal Industry (Patents) Ltd.). British Patent 1,346,566. 20 Feb 1974. Filed date 14 Nov 1969. 7p.

An apparatus is described in which objects are passed through a beam of radiation, such as in the sorting of materials, such as coal from shale. The mixture is passed on a conveyor belt through a beam of ionizing radiation and detector means are positioned in the beam to measure the radiation transmitted through the objects to be sorted. A gating mechanism is provided to deflect the wanted material on to a first path and cause the unwanted material to take a second path. The amount of ionizing radiation passing through the material depends not only on the composition of the material but also on its thickness, and it is therefore possible to obtain some mis-sorting when a large piece of wanted material passes through the beam. The apparatus described incorporates a mechanical sensing member adapted to detect the size of the object, together with attenuating means responsive to this sensing member and adapted so that the output of the radiation detector is varied in accordance with the size of the object. The attenuating means comprises radiation absorbing or reflecting material, movably positioned between the object and detector; and the mechanical sensing member may comprise a pivotally mounted finger with its free end positioned over the path of the objects on the conveyor, so that the free end may be lifted or lowered according to the size of the objects. (UK)

15708 MASS SPECTROMETER FOR DIRECT INDICATION OF ISOTOPIC ABUNDANCE RATIO. Esumi, Y.; Satooka, S. (Inst. of Physical and Chemical Research, Wako, Japan). Rikagaku Kenkyusho Hokoku; 50: No. 1, 32-38(Jan 1974). (In Japanese).

In the course of tests to improve the barriers for uranium enrichment, measurements of isotopic abundance ratios of many argon gas samples have been done continuously. It becomes necessary to carry out the measurements conveniently, precisely, and continuously. By adopting a device to keep the ion current constant during measurement, a mass spectrometer which directly indicates the value of isotopic abundance ratio without calculation was constructed. By using an automatic sample introduction equipment together with this apparatus the accuracy was very good. (auth)

15709 SIGNAL AVERAGING SYSTEM FOR ION KINETIC ENERGY SPECTROMETRY. Terwilliger, D. T.; Beynon, J. H.; Cooks, R. G. (Indiana-Purdue Univ., Indianapolis (USA)). Int. J. Mass Spectrom. Ion Phys.; 14: No. 1, 15-27(May 1974).

Ion kinetic energy spectra have been ensemble averaged by interfacing a Hewlett-Packard 2100A computer with a mass-analyzed ion kinetic energy spectrometer (MIKES). Under computer control, the electric sector voltage is scanned repeatedly over a range of up to 30% of the maximum voltage. The data for each scan is automatically averaged and this average may be plotted at any time. A paper tape may also be punched so that the data may be saved for later usage and/or further averaging. The linearity of the scan and reproducibility of the starting position have been tested in detail. The expected increase in signal to noise ratio is observed with no distortion in peak shapes. Kinetic energy release measurements agree with the results obtained by manual scans and an improvement in kinetic energy resolution is noted. (auth)

15710 TOWARD A UNIFIED VIEW OF RADIOLOGICAL IMAGING SYSTEMS PART I: NOISELESS IMAGES. Wagner, R.F.; Weaver, K.E.; Denny, E.W.; Bostrom, R.G. (Division of Electronic Products, Bureau of Radiological Health, Rockville, Maryland 20852). Med. Phys. 1: No. 1, 11-24 (May 1974).

A brief overview of the radiological imaging problem is presented, emphasizing the need for parametrizing components for the user, medical physicist, or system designer. Against this background a method is proposed for reducing MTF data. The single parameter obtained is analogous to criteria of "sharpness" used in other optical applications. The example of x-ray tube focal spots is examined in detail; results are presented and compared with other criteria. Finally, a prescription for cascading elements into a system is given and applied to the case of magnification radiography. (auth)

15711 EFFICIENCY AND RESOLUTION OF IONOGRAPHY IN DIAGNOSTIC RADIOLOGY. Fenster, A.; Plewes, D.; Johns, H.E. (Department of Medical Biophysics, University of Toronto and The Ontario Cancer Institute, 500 Sherbourne St., Toronto, Ontario, Canada M4X 1K9). Med. Phys. 1: No. 1, 1-10 (May 1974).

In ionography the x-ray photons are absorbed in a high-pressure gas between the parallel plates of an ion chamber and the ions produced are collected on an insulating foil covering one of the plates. The charge pattern is rendered visible using powder-cloud development. The effects of plate separation and the nature of the gas on the images produced by x rays in the range 50 to 105 kVp have been investigated both experimentally and theoretically. Three potentially useful gases (freon 13B1, krypton, and xenon) have been studied. The energy spectrum of electrons set in motion in these gases have been calculated and the absorption efficiency determined. For a 2-cm gap with a pressure of 10 atm using x rays at 45 kVp all three gases give an efficiency of about 80% while at 105 kVp the efficiencies are 62%, 28%, and 26% for xenon, krypton, and freon, respectively. Higher efficiencies can be obtained using larger gaps. The effects of gas, gas pressure, plate separation, and x-ray spectrum on the resolving capability were calculated. Freon gives about twice the resolution of either krypton or xenon. The resolution was measured and found to be greater than 10 line pairs per mm in freon at 10 atm. Diffusion does not blur the image appreciably when positive or negative ions are collected but is important when electrons are used to form the image. Fields of the order of 25 kV/cm are required to collect 90% of the ions at exposure rates of 25 mR/sec. Our results suggest that with further technical development ionography may offer some real advantages in diagnostic radiology. (auth)

15712 IDENTIFICATION OF LINEAR SYSTEMS USING MOMENTS METHODS. Bolch, G. Karlsruhe, Ger.; Karlsruhe Univ. (1973). 148p. (In German).

With figs. and tabs.; 18 refs. With abstract. Available from the library of Karlsruhe Univ.

Diss. (D.Eng.).

Since digital computers are often used in the field of measurement and control, there is an increasing interest in identification procedures especially suited to the use of digital computers. Such a procedure is the moments method described in this work. The system parameters are determined from the moments, evaluated from the system response to a deterministic and aperiodic test signal by weighting with t^{ν} and subsequent integration. All these operations are readily done by a digital computer. If the computer is fed directly with the system response using an analog-digital converter, the identification result is obtained immediately after the decay of the transient process. (GE)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 16108 and 16489.

15713 VALINDABA: SOURCE OF ENERGY. Dellatola, L. S. Afr. Panorama; 19: No. 1, 1-5(Jan 1974).

The new enriched uranium plant at Valindaba now under construction is described. The various processes for enriching uranium are briefly described. The capital cost of a large-scale enrichment plant based on the South African process is expected to be less than 65% of that of a gaseous diffusion plant of the same capacity. The energy consumption of the South African Process has almost halved every 2 years over the past 8 years. An even further reduction is predicted. (INIS)

15714 ISOTOPE SEPARATION BY SINGLE-STAGE SWEEP DIFFUSION PROCESS. Wada, K.; Saino, K. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 11: No. 3, 91-98(Mar 1974).

A theoretical treatment of single-stage sweep diffusion process is presented. Several workers have analyzed the sweep diffusion process by assuming a relation governing the diffusion fluxes, or by approximating the boundary conditions of the concentrations. The model adopted in this theory consists of a horizontal diffusion pipe and two mixing chambers attached to each end of the pipe; these chambers act as the charge and discharge systems of the stage. The boundary conditions of the diffusion equations are given by mass balance considerations around the chambers, so that the separation factor and the diffusion fluxes can be estimated in terms of three flow rates of streams: feed, separating agent, product or waste. In the case of nitrogen isotope separation with CO_2 gas as separating agent, the calculated values of fluxes agree very closely with the experimental results. However, the magnitudes of the separation factor minus one obtained experimentally are about 16% smaller than the corresponding theoretical values. This discrepancy would appear attributable to the presence of some convective mixing through the diffusion pipe. (auth)

Isotopic Power Sources

15715 (MLM-2103) DESIGN OF A HEAT SOURCE FOR A NAVY RADIOISOTOPIC POWER GENERATOR. Anderson, C. G.; Selle, J. E. (Mound Lab., Miamisburg, Ohio (USA)). 20 May 1974. Contract AT-33-1-GEN-53. 100p. Dep. NTIS (US Sales Only) $8.25.

A study conducted for the U. S. Navy determined the most economical available fuel form and encapsulation materials for use in heat sources for volume constrained, long-term, undersea applications. The PuO_2 shard was shown to be the optimum fuel form; encapsulation can best be accomplished with T-111 spherically ended liner and strength member, and Hastelloy C or Inconel 625 clad. Earlier heat source programs are briefly surveyed and the present design logic is summarized. Sample calculations required to produce the desired design configurations and data necessary to change the design criteria are included. Estimated costs are presented. (auth)

15716 (ORNL-4978) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING MARCH 31, 1974. Ottinger, C. L. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 38p. Dep. NTIS $4.00.

Examination of the 49 compatibility test couples which were taken off test in December 1973 was started. Nonradioactive control couples representative of these 49 specimens were examined. Development of the techniques required for fabrication of the 11-couple combined compatibility/tensile strength test matrix continued. Free energy calculations were made covering possibile reactions of $^{244}Cm_2O_3$ fuel with six potential encapsulants. Helium release experiments at 500, 650, and 800°C were completed. These tests indicated that the controlling mechanism for helium release from $^{244}Cm_2O_3$ is different at different temperatures, with a change in mechanism occurring in the region of from 600 to 700°C. Vapor pressure measurements were made on $^{244}Cm_2O_3$. A 25-W $^{244}Cm_2O_3$ pellet was exposed to dry air; it exhibited a similar edge-fracturing effect as that observed in a previous test. A leach rate study was done on a sample of air-oxidized $^{244}Cm_2O_3$ fuel. Evaluation of the criticality aspects of three reference ^{244}Cm-fueled source assemblies was completed; the results indicated that no criticality problems would be expected. A re-orientation of the ^{244}Cm development program from emphasis on experimental properties measurements to emphasis on laboratory-scale development required some changes in the utilization of facilities and modification of some experimental plans. Plans were initiated for a ^{244}Cm recovery process development experimental program. (auth)

15717 (SLA-74-46) MC2730 RADIOISOTOPIC THERMOELECTRIC GENERATOR: A DEVELOPMENT REPORT. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 37p. Dep. NTIS $5.00.

An overview of the Sandia Laboratories radioisotope thermoelectric generator development program as of August 1973 is presented. (auth)

15718 (TID-26581) ARTIFICIAL HEART CONTROLS SUPPORT. Progress Report. Donovan, F. M. Jr. (Universities Center, Jackson, Miss. (USA)). 1 May 1974. Contract AT(40-1)-4485. 5p. Dep. NTIS $4.00.

The distribution of basal cardiac output in the adult population in the U. S. was determined using the age, height, weight, and sex distribution of the population from a number of sources including the 1970 Census. The cardiac reserve, that is the difference between the maximum cardiac output and the basal cardiac output, was then determined for the various groups under conditions of no anemia, moderate anemia, and severe anemia. The results are given in tabular form. (TFD)

15719 REVIEW OF NAVY RPG PROGRAM. Fleming, T. P.; Starr, M. D. (Naval Facilities Engineering Command, Alexandria, VA). Trans. Amer. Nucl. Soc.; 18: 1(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15720 PLUTONIUM-238-FUELED THERMOELECTRIC BATTERIES. Carney, H. C. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 1-2(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15721 ADVANCED LOW-POWER RTG CONCEPT. Raag, V. (Syncal Corp., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 18: 2(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15722 TERRESTRIAL RTG DESIGNS EMPLOYING WASTE MANAGEMENT CAPSULES. Hannah, R.; Hines, J. (Teledyne Isotopes, Timonium, MD). Trans. Amer. Nucl. Soc.; 18: 2-3(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15723 LOW COST: A NEW DIMENSION IN SPACE NUCLEAR POWER. Carpenter, R. T. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 6(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15724 ECONOMIC MODULAR RTG SYSTEMS. Osmeyer, W. E. (Teledyne Isotopes, Timonium, MD). Trans. Amer. Nucl. Soc.; 18: 6-7(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15725 DESIGN OF A 400-W(e) ERTG UTILIZING THE TUBULAR THERMOELECTRIC MODULE TECHNOLOGY. Parker, W. G. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 7-9(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15726 LOW-COST RING CONVERTER RTG. Carney, H. C.; Elsner, N. B. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 9-10(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15727 DESIGN OF A LOW-WEIGHT 400-W(e) ECONOMICAL ISOTOPE BRAYTON SYSTEM. Killen, R. E. Trans. Amer. Nucl. Soc.; 18: 10(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15728 DESIGN OF A 400-W(e) ERTG BASED ON LOW-TEMPERATURE ORGANIC RANKINE CYCLE TECHNOLOGY. Jones, I. R.; Boretz, J. E. (TRW Systems, Redondo Beach, CA). Trans. Amer. Nucl. Soc.; 18: 10-11(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15729 STIRLING CYCLE 400-W(e) ECONOMICAL RADIOISOTOPE THERMODYNAMIC GENERATOR. Holman, R. (Westinghouse Electric Corp., Pittsburgh); Jaspers, H. Trans. Amer. Nucl. Soc.; 18: 11-12(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15730 IMPACT OF ADVANCED RADIOISOTOPE POWER SYSTEMS ON THE DESIGN OF COMMERCIAL COMMUNICATIONS SATELLITES. Raab, B.; Karlin, J. J. (Fairchild Space and Electronics, Germantown, MD). Trans. Amer. Nucl. Soc.; 18: 15-16(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15731 APPLICATION OF ATOMIC ENERGY IN CARDIAC PACEMAKERS. Suma, K. (Tokyo Women's Medical Coll.). Tokyo Joshi Ika Daigaku Zasshi; 44: No. 2, 191-195(Feb 1974). (In Japanese).

The first human implantation of a nuclear pacemaker was performed in France in 1970. By the end of April, 1973, more than two hundred nuclear pacemakers were implanted all over the world. The radioactive material for the pacemaker was ^{238}Pu and the estimated life of the battery was about ten years. At the department of surgery, Tokyo Women's Medical College, a nuclear pacemaker using ^{147}Pm was investigated, and animal experiments were successfully carried out in 1971. The problems of a nuclear pacemaker, including contamination, surface radiation, life of electrical circuits, and social acceptability are discussed. (auth)

15732 INTEGRATED WASTE MANAGEMENT: WATER SYSTEM USING RADIOISOTOPES FOR THERMAL ENERGY. Scheikopf, J. D.; Witt, F. J.; Murray, R. W. pp 117-122 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

The development of a waste and water management system for advanced space vehicles is discussed. The unit collects and processes human wastes, waste water, and trash from four men, recovers the water, and disposes of the solid wastes. The water is purified by distillation and catalytic oxidation of the liquid wastes. The solid wastes are incinerated. ^{238}Pu-fueled heaters were tested for both the high and low temperature processes. A heat pipe was used for thermal control of the heaters. After 30 days of testing the results showed that the recovered water was sterile and potable, greater than 98% water recovery and 99% solid waste reduction was achieved, all outflows were sterile, and the radioisotope capsule radiation level was only 7.9 mRem/h unshielded at one meter. The system was considered an economical solution to spacecraft waste management problems and may solve more earthly problems. (LCL)

Radiation Sources

Refer also to abstracts 15349 and 15690.

15733 (SLA-74-5382) PICOSECOND X-RAY PULSES. Olsen, J. N.; Cuderman, J. F.; Duguay, M. A. (Sandia Labs., Albuquerque, N. Mex. (USA); Bell Telephone Labs., Inc., Murray Hill, N. J. (USA)). 1974. 14p. (CONF-740617-5). Dep. NTIS $4.00.

From 8th international quantum electronics conference; San Francisco, California, USA (10 Jun 1974).

Using a 40 psec laser pulse of 0.5 to 1 J, laser-plasma generated x-ray pulses were created and observed with full-width-half-max times of 50 psec or less. The temporal resolution of the optical sampling oscilloscope is limited by the laser pulse width to be 30 psec in this case but could be shorter with a glass oscillator. The temporal range could be increased either by adding more delay channels or by increasing the delay on the existing channels. (MOW)

15734 FISSION-FRAGMENT DRIVEN (d + t) NEUTRON IRRADIATION SOURCE FOR CTR MATERIALS DAMAGE IRRADIATIONS. Miller, L. G.; Young, R. C.; Brugger, R. M. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 18: 20-21(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15735 DISTRIBUTION PATTERNS OF FIREARM DISCHARGE RESIDUES. Pillay, K. K. S.; Driscoll, D. C.; Lee, B. W.; Jester, W. A. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 18: 61-62(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15736 SOLID-SPHERE RADIOTRACER METHOD FOR MEASURING SLOW LIQUID FLOW IN SMALL CHANNELS. Dunn, T. S.; Gardner, R. P. (North Carolina State Univ., Raleigh). Trans. Amer. Nucl. Soc.; 18: 63-64(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15737 METHOD AND MEANS FOR PRODUCING COHERENT X-RAY AND GAMMA-RAY EMISSIONS. Viecelli, J. A. (to United States Atomic Energy Commission). US Patent 3,813,555. 28 May 1974. Filed date 16 May 1973. 6p.

A method and apparatus are described for producing coherent x-ray and gamma-ray emissions by taking advantage of doppler shift phenomena and the relativistic effects of time dilation, wave vector angle compression, and length compression associated with an active optical lasing medium moving at a uniform velocity very nearly equal to the speed of light. (Official Gazette)

15738 COMPARATIVE EVALUATION OF CHECKING METHOD FOR TIGHTNESS OF SEALED RADIOACTIVE SOURCES. Mangliar, F.; Repas, L. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Izotoptechnika; 17: No. 6, 301-308(Jun 1974). (In Hungarian).

An ultrasonic checking method for tightness of sealed sources in comparison with the traditional checking methods is described. (auth)

15739 ^{52}Fe PRODUCTION FOR MEDICAL USE FROM 588-MeV-PROTON IRRADIATION OF Mn, Co, Ni, AND Cu TARGETS. Sodd, V.J.; Scholz, K.L. (DHEW, Bureau of Radiological Health, University of Cincinnati College of Medicine, Cincinnati, Ohio 45229); Blue, J.W. Med. Phys. 1: No. 1, 25-28 (May 1974).

The average cross sections for ^{52}Fe production from the bombardment of 588-MeV protons on manganese, cobalt, nickel, and copper targets were measured as 0.066 ± 0.013, 0.152 ± 0.012, 1.35 ± 0.30, and 0.148 ± 0.013 mb, respectively. A simple chemical procedure for the dissolution of the target in mineral acid and the extraction of ^{52}Fe into di-isopropyl ether is described. The long-lived radiocontaminants in an ^{52}Fe product from a single extraction of a nickel target irradiated for 0.5 h were ^{44}Sc (0.02%), ^{44m}Sc (0.11%), ^{47}Sc (0.01%), ^{48}V (0.14%), ^{55}Fe (3.3%), and ^{59}Fe (0.16%). (auth)

Design and Fabrication

Refer also to abstract 15850.

15740 DEVELOPMENT OF ^{252}Cf SEALED SOURCES AT THE COMMISSARIAT A L'ENERGIE ATOMIQUE. Barthelemy, R.; Berger, R.; Boucher, R.; Hayet, L. (CEN, Fontenay-aux-Roses, Saclay, France). Trans. Amer. Nucl. Soc.; 18: 75-76(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

Industrial Uses

Refer also to abstracts 14752, 14929, 14933, 15315, 15797, 15802–15804, 15806–15817, 15819, and 15820.

15741 (CEA-CONF-2605) PRESENT SITUATION OF THE PRODUCTION AND USE OF RADIOISOTOPES IN FRANCE. Fisher, C. (CEA, 75-Paris (France)). [nd]. 7p. (CONF-731116-3). Dep. NTIS (US Sales Only) $4.00.

From 11th conference on radioisotopes; Tokyo, Japan (13 Nov 1973).

Current and proposed uses of radioisotopes in the medical, biological, and industrial fields in France are discussed. During 1973 the C.E.A., sole large-scale producer of radioisotopes in France, produced 40 million F worth of radioisotopes, half for domestic consumption and half for sale to foreigners. Approximately 65% of this is used in medicine, 10% in biology, and 25% in industry. Specific uses in each of these fields are described. (LCL)

15742 (INIS-mf-1168/2, pp vp 22p) APPLICATION OF NUCLEAR TECHNIQUES IN INDUSTRY AND ENVIRONMENTAL STUDIES. Kuusi, J. (Technical Research Centre of Finland, Otaniemi). 1973.

The application of nuclear techniques on the problems of industry and environmental studies are described using some illustrating examples of the work carried out by The Reactor Laboratory of The Technical Research Center of Finland which has a 250 kW TRIGA research reactor at its disposal. These examples consider the following areas: neutron activation analysis, radioisotope x-ray

techniques, industrial process studies using radioisotope tracers, and surface water flow studies using radioisotope tracer techniques. (INIS)

15743 (INIS-mf-1313) SCIENTIFIC VISIT IN THE USE OF RADIOISOTOPES IN INDUSTRY AND HYDROLOGY IN THE UNITED KINGDOM, DENMARK, SWEDEN, AND FRANCE. Rozental, J. J. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro. Departamento de Fiscalizacao de Material Radioativo). 1973. 76p. INIS.

Results are given of a scientific visit to review the use of radioisotopes in industry and hydrology in the United Kingdom, Denmark, Sweden and France. Radioisotopes are being used in industry: to measure and control manufacturing processes; to inspect material, parts and finished products; and to determine the cause of processing difficulties. Radioisotopes can be used safely, provided that adequate radiation protection programs are established and that acceptable working conditions are maintained. (INIS)

15744 CALIFORNIUM-252: AN EDUCATIONAL RESOURCE. Courtney, J. C. (Louisianna State Univ., Baton Rouge, LA). Trans. Amer. Nucl. Soc.; 18: 29-30(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, Pennsylvania, PA (23 Jun 1974).

15745 NUTRITIONAL AND COMPOSITIONAL CHANGES IN DEHYDRO-IRRADIATED SHRIMP. Srinivas, H.; Vakil, U. K.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). J. Food Sci.; 39: No. 4, 807-811(1974).

Nutritional and compositional changes in dehydro-irradiated shrimp were studied and compared with those in samples processed by conventional procedures. No changes in proximate constituents are observed due to radiation treatment, though blanching causes some loss in total proteins. Losses in B vitamins due to radiation are much less than those due to blanching and partial drying. Radiation-induced losses can be minimized by packing the samples in vacuum or nitrogen atmosphere prior to irradiation. A progressive loss up to 22% of B vitamins is observed in processed shrimp during 3 months storage at ambient temperature. No losses in total amino acids or in available lysine are observed in irradiated samples, while thermal treatment results in some losses. In vitro enzymic digestibility of shrimp protein is increased by radiation treatment. (auth)

15746 CALIFORNIUM-252 PROGRESS, NUMBER 17, MAY 1974. Californium-252 Progr.; No. 17, 1-56(May 1974).

The fourth ^{252}Cf utilization meeting and workshop was held in San Diego on April 22 to 24, 1974. The discussions in the six workshops indicated that application of ^{252}Cf is now accepted by many organizations as an important approach, especially in nondestructive testing, activation analysis, nuclear materials assay, and process control. In the workshop on aerospace application of ^{252}Cf it was announced that ^{252}Cf neutron radiography had been used successfully to radiograph flightline aircraft in the field for the first time. About 44 mg of ^{252}Cf has been sold to date. Recent orders were received from the Commissariat a l'Energie Atomique, France, and the European Institute for Transuranium, Karlsruhe, West Germany. A new ^{252}Cf medical source (seed assemblies) is described that provides greater flexibility when implanting source assemblies, provides an assortment of assemblies, and reduces the radiation dose to hospital personnel. The application of ^{252}Cf in the following fields is also reviewed: radiotherapy, neutron radiography, quality control, neutron activation analysis, pollution control, and nuclear safeguards. (LCL)

15747 NEW POSSIBILITIES OF LUBRICANT TESTING BY MEANS OF THE RADIONUCLIDE TECHNIQUE. Ruedinger, V. (Kernforschungszentrum Karlsruhe (F. R. Germany). Lab. fuer Isotopentechnik). Kerntechnik; 16: No. 4, 164-169(Apr 1974). (In German).

8 figs.; 11 refs.

The continuous measurement of wear by means of radionuclides within the scope of lubricant testing has produced interesting results. Due to the constant wear behavior after running-in, together with the very high resolution, the test times can be considerably reduced. The possibility of multiple use of wear partners has been indicated which is of very great importance with respect to economics, measuring accuracy and also to the development of optimum lubricant formulations. The measurement of the effective viscosity of structurally viscous oils in plain bearings is possible exactly at transition from purely hydrodynamic to boundary lubrication by means of the radionuclide technique. The x-ray method presents a rapid measuring method for studying directly on the running unit, the foaming behavior of oils and the factors of influence. (GE)

15748 AN APPLICATION OF RADIOISOTOPE XRF TECHNIQUE IN THE FIELD OF TRIBOLOGY. Frazzoli, F. V.; Salmi, M. (Rome Univ. (Italy). Istituto di Fisica). Kerntechnik; 16: No. 4, 163-164(Apr 1974).

5 figs.; 3 refs.

A radioisotope XRF technique has been developed for the real time monitoring of mass transfer during friction between different unlubricated metals. Experimental results show clearly that one can easily determine the evolution of mass transfer with good sensitivity and accuracy. It turns out that laboratories concerned with the study of transient phenomena occurring during friction can take advantage of the proposed technique which is simple, inexpensive and safe. (GE)

15749 RADIONUCLIDE EXPERIMENTS ON THE WEAR PERFORMANCE AND THE LOAD-BEARING CAPACITY OF SLIDING BEARINGS. Katzenmeier, G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Lab. fuer Isotopentechnik). Kerntechnik; 16: No. 4, 152-157(Apr 1974). (In German, English).

7 figs.; 8 refs.

The continuous measurement of wear by means of radionuclides (deuteron activation) offers the possibility of determining with great sensitivity the limits of safe, wear-free running of sliding bearings. Wear measurements on cylindrical bearings under static and dynamic loads were carried out on a test stand. The experiments yielded information on the basic running-in and wear performance of sliding bearings, as well as on the effects of shaft/shell materials pairing and of the surface characteristics on the rate of wear and on the load-bearing capacity. (GE)

15750 FARAH-ABAD GAS LINE TEST USING A RADIONUCLIDE. Kasrai, M.; Panahandeh, H.; Pazirandeh, A.; Bozorgcami, S. (Teheran Univ. (Iran). Nuclear Centre). Kerntechnik; 15: No. 9, 424-425(Sep 1973).

2 figs.; 6 refs.

The Ministry of Water and Power requested the Teheran University Nuclear Center to examine one of their newly built gas pipe lines for probable blockage or depression. The test was carried out using a pig which was snugly fitted inside the pipe. The pig was forced to move in the pipe by supplying pressurized water behind it. In order to trace the movement of the pig, a 1 Ci sealed source of ^{140}La was placed inside the pig. The test took about 20 hours to complete and no fault was found in the pipe. (GE)

15751 RUBBER AND RADIATION. I. Utilization of Radioisotopes in rubber industry. Takahashi, Y. (Yokohama Rubber Co. Ltd., Tokyo). FAPIG (Tokyo); No. 66, 117-124(Aug 1972). (In Japanese).

Radioisotopes exhibit the same chemical behavior as stable isotopes. These properties as used in the rubber industry are described, reviewing the world developments in this field. The radioisotope uses include: tracer studies of the diffusion of sulfur and other additives in rubber, tracer studies of the dispersion, and distribution of additives in rubber, carbon-black reinforcement of rubber, and measurement of rubber tire abrasion, on-line processing in rubber factories, and nondestructive testing. (JA)

15752 WOOD-POLYMER COMPOSITE. Gotoda, M. (Japan Atomic Energy Research Inst., Osaka). Kogyo Zairyo; 21: No. 9, 10-22(Sep 1973). (In Japanese).

Wood-polymer composite (hereafter called WPC) is a new industrial material. In the process of production, wood material is impregnated with polymer which polymerizes and improves the properties of the wood. WPC can be used easily without requiring a heating press. Thermosetting resin can be formed in vinyl polymerization mechanism by using monomer with a prepolymer and a cross-linking agent. The WPC can be expected to have a variety of industrial advantages, e.g., the removal of solvent and unreactive monomer is unnecessary because of 100% of conversion efficiency. A problem is the adhesion of the internal surface of wood matrix. A hydrophobic polymer should be used to improve the adhesion to the wood. In radiation polymerization, electron beams can be used for thin coatings, but gamma-rays should be used for thick coatings because of their highly penetrating distance. The influence of dose rate on the chemical radiation hardening of polymers in wood, the properties of WPC, and the apparatus of Vitro Engineering Co. are illustrated. (JA)

15753 APPLICATION OF IONIZING RADIATION TO STERILIZATION. Sztanyik, B. L. Izotoptechnika; 17: No. 6, 265-300 (Jun 1974). (In Hungarian).

Radiation sterilization of medical and biological articles is described. Developments and IAEA's activity in this field are discussed. (2 references) (auth)

LIFE SCIENCES

15754 (CONF-730228-) PROCEEDINGS OF THE SYMPOSIUM ON CONTROL MECHANISMS IN CELLULAR PROCESSES, BOMBAY, INDIA, FEBRUARY 1–3, 1973. (Department of Atomic Energy, Bombay (India). Biology and Medical Committee). 1973. 714p.

Separate abstracts were prepared for 10 papers presented at this symposium. Fifty-seven additional papers discuss various aspects of cellular physiology. (CH)

For abstracts of individual papers see: 15760–15762, 15778, 15791–15793, 15909, 15910, and 16067.

15755 (UR-3490-551) BRIEF DESCRIPTION OF RESEARCH PAPERS ACCEPTED FOR PUBLICATION DURING 1973. Annual Report. Neuman, W. F. (Rochester Univ., N. Y. (USA). Atomic Energy Project). 15 Jun 1974. Contract AT(11-1)-3490. 138p. Dep. NTIS $5.45.

Brief summaries are presented of 99 papers accepted for publication during 1973 that report results of research studies completed in the fields of radiobiology, biochemistry, physiology, and molecular biology. (CH)

15756 HISTORICAL SURVEY OF SPACE RADIATION BIOLOGY. Tobias, C. A. (Univ. of California, Berkeley); Todd, P. pp 1-20 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

The biological significance of ionizing radiations encountered in space is discussed. It is pointed out that space radiations fall into three general categories: cosmic radiation, trapped radiation belts around the earth, and solar radiation. Biological experiments on the ground involving space radiations are reviewed and it is concluded that such experiments are difficult to perform and the results are difficult to evaluate. (67 references) (CH)

15757 RADIATION AND MOLECULAR AND BIOLOGICAL EVOLUTION. Tobias, C. A. (Univ. of California, Berkeley); Todd, P. pp 197-255 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Various theories concerning the origin of life on earth are discussed. Data on the interactions of radiations incident upon the upper atmosphere and their physical and chemical interactions relevant to influences exerted in the biosphere are reviewed. Radiochemical reactions involved in the origin of life and the evolution of species are postulated. Examples of the biological evolution of bacteria, algae, invertebrates, fish, insects, reptiles, and mammals based on chemical, morphological, and paleomicrobiological evidence are discussed in relation to evidence of changes in magnetic fields during the last four million years. The hypothesis that increased radiation dose rates accompanying terrestrial field reversals increased evolution rates by increasing mutation rates is discussed. (240 references) (CH)

15758 BIOLOGICAL MICROIRRADIATION: CLASSICAL AND LASER SOURCES. Berns, M. W. Biological Techniques Series. Englewood Cliffs, NJ; Prentice-Hall, Inc. (1974). 159p. $9.95.

Basic principles of radiation biology, equipment design and operation, and inherent limitations of the technique of microirradiation are discussed. Experiments are described to provide information to investigators considering this approach. Basic principles are also considered. The seven chapter titles are: introduction; instrumentation; radiation classification and sources; radiation, matter, and dosimetry; the cell; organisms, gametes, and embryos; and ultrastructure. (125 references). (MCG)

15759 PROCEEDINGS OF THE REGIONAL CONFERENCE ON RADIATION PROTECTION. Volume 1. Conference Held in Jerusalem, Israel, March 5–8, 1973. Feige, Y.; Schlesinger, T. (eds.). Yavne, Israel; Soreq Nuclear Research Centre (1973). 461p. (CONF-730345-P1).

Separate abstracts were prepared for 32 of the 33 papers included. An abstract of one paper appeared in NSA previously as number 29: 11682. (CH)

For abstracts of individual papers see: 15386–15388, 15426, 15588, 15589, 15634–15638, 15649, 15773, 15774, 15790, 15845, 15903–15908, 15968, 16010, 16062, 16122, 16557, 16672, 17475–17477, and 18037.

Radiation Effects on Biochemicals

Refer also to abstracts 14930, 14932, 15782, 15786, 15836, and 15911.

15760 (CONF-730228-, pp 49-60) STRUCTURAL ALTERATIONS IN IRRADIATED MYOGLOBIN. Paul, P.; Madhaven, V. N.; Kumta, U. S. (Bhabha Atomic Research Centre, Bombay). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

Effects of radiation on the structure-function relationship of myoglobin molecule have been extensively studied. It was observed that even though myoglobins from various species are structurally similar, offering two major sites for radiation damage (protoporphyrin nucleus and the apoglobin moiety), they differ greatly in their responses to radiation. In the case of fish myoglobins known to contain sulphydryl groups, metmyoglobin was converted to oxymyoglobin as a result of irradiation (50 and 100 Krad), as evidenced by their spectral pattern. On the other hand, lamb meat myoglobin devoid of sulphydryl groups, showed anomalous spectral behavior when subjected to different doses of radiation. Differences were also observed in the occurrence of microheterogeneity; lamb meat myoglobin separating into two colored fractions (LM I and LM II) on sephadex G-100 column, each of these fractions resolving further into 3–4 bands on polyacrylamide gel electrophoresis. Indian salmon and black pomfret myoglobins did not exhibit microheterogeneity. The effects of radiation on the catalytic function of myoglobin in autoxidation are also discussed. (auth)

15761 (CONF-730228-, pp 155-163) EFFECT OF X-IRRADIATION ON DNA SYNTHESIS DURING VARIOUS PHASES OF CELL CYCLE IN THE UTERUS OF OVARIECTOMIZED MICE. Bhattacharjee, D. (Bhabha Atomic Research Centre, Bombay). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

The effect of varying doses of whole body x-irradiation, namely, 200, 400, 600, 800 and 1600 R, on presynthetic (G1) and synthetic (S) phases of the cell cycle of estrogen administered ovariectomized mouse uterus was studied with respect to DNA synthesis. Results showed that the G1 cells were very sensitive in terms of DNA synthesis even to low doses of irradiation. The S cells, on the other hand, were comparatively less radiation sensitive, high doses of x rays being required to produce significant inhibition of DNA synthesis. The biochemical aspects of the differential behavior in radiation sensitivity of DNA synthesis of cells in presynthetic and synthetic phases are discussed. (auth)

15762 (CONF-730228-, pp 531-544) KINETIC STUDY OF SUPEROXIDE DISMUTASE IN NORMAL HUMAN ERYTHROCYTES AND ITS POSSIBLE ROLE IN ANEMIA AND RADIATION DAMAGE. Ahuja, B. S.; Nath, R. (Postgraduate Inst. of Medical Education and Research, Chandigarh, India). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

Recently erythrocuprin from erythrocytes has been shown to have superoxide dismutase activity which breaks up the superoxide formed inside the red blood cells. As no data on the human enzyme have been reported, a study was undertaken to characterize this enzyme. A very simple assay method using the inhibiting property of this enzyme of the oxidation of adrenaline to adrenochrome has been used. Erythrocytes were collected from fresh normal heparinized blood and washed with Normal Saline. These were then diluted with distilled water (1:10) and the resulting hemolysate was centrifuged at 5000 r.p.m for 15 minutes. The supernatant was used for enzyme assay. Kinetics of the enzyme i.e., effect of enzyme and substrate concentration, pH, temperature, and EDTA were studied. Alterations in enzyme activity have been observed in anemia and radiation. The data are discussed and the possible role of this enzyme in radiation injury is evaluated. (auth)

15763 (COO-3571-10) CURRENT KNOWLEDGE OF THE FORMATION AND REPAIR OF DNA DOUBLE-STRAND BREAKS. Hutchinson, F. (Yale Univ., New Haven, Conn. (USA). Dept. of Molecular Biophysics and Biochemistry). 1974. 8p. (CONF-740231-2). Dep. NTIS $4.00.

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

The types of double-strand breaks in DNA are described, and information on the number produced by x rays and on the repair of breaks is summarized. Breaks produced by enzymes, bleomycin, and ^{125}I decay in iodouracil are also discussed. (HLW)

15764 (RLO-2225-T-15-18) PHOTOBIOLOGY AND PHOTOCHEMISTRY OF RIBONUCLEIC ACIDS. Progress Report, August 1973–March 1974. Gordon, M. P. (Washington Univ., Seattle (USA)). 1974. Contract AT(45-1)-2225. 9p. Dep. NTIS $4.00.

Suppression of the MDV-1 background in preparation of Qβ replicase, effects of uv on seedlings of Nicotiana tabacum var. Xanthi, uv inactivation of cauliflower mosaic virus, photorepair induced by tryptophan residues in proteins and by indole compounds, and photoreactivation of RNA are discussed. (MCG)

15765 CELLULAR RADIATION BIOLOGY. Todd, P. (Pennsylvania State Univ., University Park); Tobias, C. A. pp 141-195 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Data are reviewed from laboratory studies on the biological effects of heavy particle irradiation on molecules of biological interest, DNA, enzymes, viruses, yeast, bacteria, and cultured mammalian cells as a function of LET and dose-response relationships. The modifying effects of age, cell cycle, oxygen, and biological recovery from sublethal injury following acute or chronic exposure are discussed. The RBE of heavy particles and x radiation are compared. Results are included from studies on the effects of high-speed heavy nuclei of primary cosmic radiation on seeds and mice exposed during space flight that indicated that the major effects of heavy ions were manifest in developing cells and that the biological effects increased in relation to LET. Data are also summarized from studies on the response of bacteria and cultured mammalian cells to uv radiation at various wavelengths that indicate that the maximum biological effect occurs around 2700 Å. (160 references) (CH)

15766 BIFUNCTIONAL PHOTOBINDING OF PSORALEN TO SINGLE STRANDED NUCLEIC ACIDS. Marciani, S.; Terbojevich, M.; Dall'Acqua, F.; Rodighiero, G. (Univ., Padua). Z. Naturforsch., 28c: 370-375(1973).

As psoralen and other furocoumarin derivatives, intercalated between two base pairs of native DNA, under irradiation at 365 nm form interstrand crosslinkings as a consequence of bifunctional addition, the writers have investigated the ability of psoralen to give such bifunctional photoadditions, too, with nucleic acids with disordered or partilly disordered structure (denatured DNA and r-RNA). On the basis of fluorimetric, light-scattering, viscosimetric measurements and of the renaturation ability of denatured bacterial DNA, certain results have been obtained. In addition to monofunctional photoadditions, psoralen can give bifunctional binding by irradiation at 365 nm both with denatured DNA and with r-RNA. However, when irradiation of denatured DNA in the presence of psoralen was performed in a concentrated solution (0.4%), the formation of bifunctional additions between two different strands was demonstrated by the increase (50%) of molecular weight of denatured DNA. However, when irradiation of denatured DNA was performed in more dilute solutions (0.1%), the bifunctional photoaddition of psoralen took place producing only bifunctional additions in the same strand, very probably with the formation of loops, as has been shown by the absence of increase of molecular weight of DNA and by the more restricted structure assumed by the macromolecule, revealed by the light-scattering and viscosimetric measurements. The formation of these bifunctional additions was confirmed by the reduced rate of renaturation shown by denatured bacterial DNA after irradiation in the presence of psoralen. In the case of r-RNA, psoralen, when irradiated can form bifunctional additions only in the same strand. (auth)

15767 PHOTOCHEMISTRY AND PHOTOBIOLOGY OF NUCLEIC ACIDS AND THEIR STRUCTURAL UNITS. Loeber, G.; Kittler, L. (Zentralinstitut fuer Mikrobiologie und Experimentelle Therapie, Jena, Ger.). Stud. Biophys.; 41: No. 2, 81-153(1973). (In German).

A review is presented on recent experimental and theoretical data on the photochemistry and photobiology of nucleic acids and their components. The topics discussed are photoreactions of nucleic acids and their components, photoreactions of furocumarine with nucleic acids, sensitized photoreactions, and recovery of photodamage. (533 references) (JSR)

15768 NEAR-ULTRAVIOLET MODIFICATION OF ESCHERICHIA COLI B UBIQUINONE IN VIVO AND IN VITRO. Werbin, H.; Lakchaura, B. D.; Jagger, J. (Texas Univ., Dallas). Photochem. Photobiol.; 19: No. 5, 321-328(May 1974).

Ubiquinone Q-8 in Escherichia coli B was labeled by growing the bacteria in a synthetic growth medium containing p-hydroxybenzoic acid-^{14}C (U). The cells were then irradiated with light of wavelengths 313, 334, 366, and 405 nm, and Q-8-^{14}C was extracted and assayed. Q-8-^{14}C was also isolated from unirradiated bacteria, partially purified, and then irradiated similarly in hexane and assayed. Ubiquinone in the cells was four to eight times as resistant to radiation as ubiquinone in hexane. From 313 to 366 nm, the in vivo and in vitro action spectra similar to each other and to the absorption spectra of synthetic Q-8 dissolved in the hexane or ethanol, but at 405 nm the action spectra deviated from the absorption spectra. Quantum yields for the modification (loss) of ubiquinone in hexane decreased from 0.021 at 313 nm to 0.005 at 405 nm. The chromenol of Q-8 was not detected in labeled cells irradiated at 334 nm, but several more-polar photoproducts were separated by thin-layer chromatography. (auth)

15769 ENERGY REQUIREMENTS FOR DAMAGING DNA MOLECULES. II. Energy Transfer from Metastable States of Excited Gases to Double-Stranded PHI X174 RF-DNA. Luecke-Huhle, C.; Jung, H. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 25: No. 4, 339-349(Apr 1974).

The double-stranded replicative form (RF) of DNA from bacteriophage φX174 was exposed to metastably excited gases in extremely thin layers. The loss of plaque-forming ability and the frequency of single-strand breaks was measured in a spheroplast system and by centrifugation in neutral and alkaline sucrose gradients, respectively. The excitation energy of the various gases used amounts to 4.3 eV for H_2^*, 6.2 eV for N_2^*, 11.6 eV for Ar*, and 19.8 eV for He*. These energies were transferred to the RF-DNA molecules by collisions of the second kind. They are shown to produce identical effects on DNA. It is shown that the actions of excited gases and that of Co γ-radiation on φX174 RF-DNA differ in many respects. (1) Single-strand breaks caused by excited gases do not measurably destroy the plaque-forming ability of the double-stranded φX174 RF-DNA; twenty (and possibly considerably more) single-strand breaks either do not interfere with the replication process, or are repaired with high efficiency in the host cell. (2) Excited gases do not produce inactivating base and/or sugar damage, whereas after γ irradiation, the loss of plaque-forming ability is mainly caused by this type of damage. (3) Excited gases do not induce alkali-labile bonds whereas after γ-irradiating DNA in the dry state, 22% of the single-strand breaks determined by centrifugation in an alkaline sucrose gradient originate from alkali-labile zones. (auth)

15770 HAEMOGLOBIN, A SULPHHYDRYL-PROTEIN IN THE BINDING REACTION WITH RADIOPROTECTIVE MEG. Horvath, M.; Csagoly, E. (Orszagos Onkologiai Intezet, Budapest). Int. J. Radiat. Biol.; 25: No. 4, 351-359(Apr 1974).

Hemoglobin (Hb) in the form of oxyhemoglobin is bound to the radioprotector MEG through its reactive SH-groups. Prolonged reaction time, alkaline pH, and urea enhanced the reactivity of the unreactive ("masked") SH-groups of Hb to the radioprotector. The binding of MEG to the β-93 SH-groups of Hb increased the chromatographic and electrophoretic heterogeneity of the macromolecule. On ^{60}Co γ-irradiation, the mixed disulphide bond between Hb and MEG was not broken but stabilized, provoking structural changes, resulting in denaturation. The denatured protein retained the firmly bound radioprotector; the mixed disulphide bond resisted splitting with thiols after being irradiated. (auth)

15771 EFFECT OF ERGOTHIONEINE ON GAMMA-IRRADIATION OF METMYOGLOBIN. Motohashi, N. (Kobe Women's Coll., Japan); Mori, I.; Sugiura, Y.; Tanaka, H. Radioisotopes (Tokyo); 22: No. 8, 451-452(Aug 1973).

Metmyoglobin was irradiated with γ rays from a 100 Ci ^{137}Cs source (~3600 R/h) in 0.1 M Tris-HCL buffer of pH 7.0 at 25° in the presence of oxygen in the dark. Following γ irradiation with 60,000 R, the light absorption spectrum of metmyoglobin was markedly changed from that of original metmyoglobin. On the contrary, when metmyoglobin was irradiated in the presence of 0.5 mM ergothioneine in a molar ratio of 10:1 to metmyoglobin, there occurred no significant change of the spectrum. This observation indicates that metmyoglobin remains intact because of the radioprotective effect of ergothioneine. (ERB)

15772 ACTION OF DNA POLYMERASE I ON γ-IRRADIATED DNA. Landbeck, L.; Hagen, U. (Kernforschungszentrum, Karlsruhe, Ger.). Biochim. Biophys. Acta; 331: 318-327(21 Dec 1973).

The action of DNA polymerase I (EC 2.7.7.7) on DNA containing 3'-hydroxyl terminated single-strand breaks and on DNA γ-irradiated in dilute solution was studied. The incorporation of deoxyribonucleotides into 3'-hydroxyl terminated DNA by DNA polymerase I increases with increasing concentration of 3'-hydroxyl end groups leading to a Michaelis constant K_m of $33 \cdot 10^{-9} \pm 5 \cdot 10^{-9}$ M (±S.E.) internal 3'-hydroxyl end groups. Gamma-irradiated DNA is ineffective as a primer template for DNA polymerase, despite carrying a number of single-strand breaks. In addition, there is an inhibition of nucleotide incorporation into 3'-hydroxyl terminated DNA when γ-irradiated DNA is added. From the concentration of 3'-end groups in γ-irradiated DNA the dissociation constant of the enzyme inhibitor complex K_i was calculated to amount to $2.5 \cdot 10^{-9}$ M. The inhibition effect of γ-irradiated DNA is due neither to the 3'-phosphate terminals nor to the denatured parts present in these molecules. Base damage formed by ultraviolet irradiation is also ineffective as inhibitor. Treatment of γ-irradiated DNA with exonuclease III, leading to the removal of several nucleotides from

the 3'-terminal of the single-strand break, causes a partial restoration of the template activity. It was concluded that the inhibitory end groups in irradiated DNA are located preferably on the 3'-terminal of the radiation induced single-strand break. (auth)

15773 REPAIR OF RADIATION DAMAGE: AN ACTIVE BIOLOGICAL PROCESS. Lion, M. (Israel Inst. for Biological Research, Nes Ziona). pp 341-347 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Damage to a biological system can be repaired by either replacement or repair of damaged entities. Repair occurs at a cellular level. As DNA is the major target of radiation damage, its repair is of cardinal importance. Mechanisms exist at the cellular level that minimize changes in the DNA molecule. These mechanisms also repair radiation damage, within the limits with which they can cope, and have indeed been studied in connection with uv damage. Recent evidence shows that these mechanisms also act on damage in DNA caused by carcinogenic agents. DNA contains the genetic message in a redundant form. The major principle of repair is the expulsion from the molecule of the damaged part and its replacement by the correct message copied from the undamaged redundant information. This information can come from the opposite strand of the same molecule, or from a sister molecule. If no such undamaged information is available, the lesion must necessarily be lethal. Four enzymatic steps of repair are recognized, including incision close to the lesion in the molecule; excision of the damaged structure; repair replication, that is a reconstruction of the correct insert; and rejoining of the pieces. These steps can be studied by methods of molecular biology and analyzed separately by using genetic mutants deficient in one or more of the above steps. The above mechanism repairs potentially lethal lesions. In x-irradiated mammalian cells repair of sublethal damage (that is, a lesion which by itself is not lethal, but becomes lethal if enough lesions are accumulated) was examined kinetically, by using split doses of radiation. The molecular basis of this mechanism and its relation, if any, to DNA repair have as yet not been clearly elucidated. (auth)

15774 PHOTOPRODUCTS AND THEIR SIGNIFICANCE IN RADIATION DAMAGE REPAIR. Riklis, E. (Nuclear Research Center-Negev, Beersheba, Israel). pp 363-378 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Since the discovery that thymine dimers (TT) are produced in DNA by uv irradiation and form the main damage site, major advances have been made towards elucidating the biochemical mechanisms of radiation damage and repair of viruses, bacterial, plant cells, and mammalian cells. It has been shown that the process of photoreactivation involves splitting of thymine dimers in situ, while dark repair occurs by excision of thymine dimers followed by enzymatic steps which restore the DNA. Dark repair has been also demonstrated in vitro. This has led to new interest in photoproducts, their role in radiobiology and the conditions for their formation in relation to their effect. Simulating space conditions, irradiation of dry DNA in vacuum resulted in decreased production of TT coupled with the appearance of another photoproduct, later identified as the spore product, which is also reparable. Another radioactive peak which appeared in a radiochromatogram of hydrolyzed DNA at Rf value of around 0.40 in a butanol-acetic acid-water system remained unknown. This product appears also in DNA irradiated at 85°C. Irradiation of cold thymine in tritiated water gave several labeled products, none of which was thymine dimer. An investigation of photoproducts formed under different conditions from irradiation of thymine was therefore carried out, giving seven photoproducts which are: trimer, dimer (cis-syn), adduct, dimer (cis-anti), urea, dihydrothymine and n-propyl urea. Thymine irradiated in frozen glycerol gave no thymine dimer, indicating a certain quenching effect of alcohols. Irradiation of DNA at 85°C gave less TT and more uracil and urea. Dependence of dose, temperature, concentration, and sensitization on the formation of photoproducts is discussed. It is suggested that all these photoproducts could have been formed and play a role in galaxial evolutionary processes. (auth)

15775 FUNDAMENTAL PROBLEM IN RADIATION BIOLOGY. Dugan, V.; Trujillo, R. (Sandia Labs., Albuquerque, N. Mex.). J. Theor. Biol.; 44: No. 2, 397-401(Apr 1974).

It has been stated (Ginoza, Annual Review of Microbiology, Palo Alto, California, p325 (1967)) that one of the fundamental problems in radiation biology is the apparent conflict between the evidence that (1) the radiation dose required to reduce a surviving population to e^{-1} of its original population (D_{37} value) decreases as the order of the system moves from viruses to vertebrate cells and (2) the number of ionizations per cell required to inactivate that cell increases as the order of the system goes from viruses to vertebrate cells. This seeming contradiction is discussed here. A table of 39 different biological entities is presented which represent the sum of the biological systems for which both nucleic acid content and radiosensitivity data could be obtained from a search of the literature and illustrates the point that as the nucleic acid contents of biological systems increase the D_{37} values for these systems decrease. It is shown that rather than being an anomaly, the apparent contradiction between decreasing D_{37} values and increasing ionizations numbers required for inactivation of biosystems with increasing nucleic acid content is simply a result of the fractional power dependence of D_{37} on nucleic acid weight. (UK)

15776 THEORY OF CO-OPERATIVE FORMATION OF DEFECTS IN DNA MOLECULE UNDER ULTRAVIOLET IRRADIATION. Vologodskii, A. V.; Frank-Kamenetskii, M. D.; Lukashin, A. V. (Inst. of Atomic Energy, Moscow). J. Theor. Biol.; 44: No. 2, 271-286(Apr 1974).

The process of thymine dimers formation in DNA under the action of uv irradiation was analyzed theoretically taking into account the long-range transfer of electronic excitation along the molecule. First, for the case of homopolymer (poly dA.dT) an exact analytical solution of the problem was obtained. For the case of random walks of excitation as well as for the case of its directional motion the distribution functions of undamaged regions on their lengths were calculated. These functions turned out to differ drastically from a trivial exponential distribution taking place without excitation's transfer. At the same time the transfer of excitation leads to the effect of thymine dimers clustering; the new dimers are formed mainly in the vicinity of dimers formed earlier. The degree of clustering γ (the mean number of dimers per cluster) depends quadratically on the concentration of clusters C in the homopolymer for the case of random walks of excitation. For the case of a heteropolymer having inhomogeneous distribution of potential dimers (two thymines situated one by one in the same strand) a machine algorithm for numerical solution of the problem by the Monte-Carlo method has been proposed. Calculations for the heteropolymer with a random sequence of bases have shown that in this case the curve $\gamma(c)$ is S-shaped and its form agrees with the experimental one obtained by Shafranovskaya et al (Zh. Eksp. Teor. Fiz. Pis. Red.; 15: 404 (1972)). The values of parameters providing the best agreement between theory and experiment have been obtained. Using these values of parameters the calculations of distribution function of undamaged regions and curves $\gamma(c)$ for different concentrations of AT-pairs in DNA were performed. These calculations show that the degree of clustering γ rises dramatically with increasing concentration of AT-pairs in DNA. Theoretical predictions which can be tested experimentally have been summarized. (auth)

15777 HISTOPHOTOMETRIC STUDY OF THE PHOSPHATASE ACID ACTIVITY OF THE LIVERS OF IRRADIATED MICE. Neveux, Y.; Gounon, P.; Drouet, J.; Guillouzo, A.; Vaurette, D. (Centre de Recherches du Service de Sante des Armees, Clamart, France). Compt. Rend. Soc. Biol.; 167: No. 6, 810-814(1973). (In French).

Histophotometric studies of acid phosphatase of the livers of mice subjected to 810 R of x radiation revealed a large early increase in acid level during the first 24 hours after irradiation, followed by a drop, a minimum valve being reached on the fifth day after irradiation, and a final return to the normal value ten days after irradiation. These polyphasic variations are difficult to interpret, especially those associated with the initial rise, which appear to be due to an aggression by the ionizing radiation. The results obtained can be interpreted as being due to several cellular processes (generally nonsynchronous), the coupling of which explains the observed polyphasic behavior. (FR)

Radiation Effects on Cells

Refer also to abstracts 15765, 15775, 15823, 15846, 18111, and 18117.

15778 (CONF-730228-, pp 671-679) DO MAMMALIAN CELLS HAVE A RECOMBINATION REPAIR SYSTEM? Errera, M.; Rommelaere, J. (Univ. Libre, Brussels). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

Chinese hamster cells (V79) have a low activity of excision repair of uv induced pyrimidine dimers. However when incubated after irradiation with 2.10^{-3} M of caffeine, the $D_{\frac{1}{2}}$ dose is decreased by almost one order of magnitude suggesting that caffeine is inhibiting

some other repair mechanism. One possibility is the existence of a mechanism similar to the rec A dependent post replicative gap filling system of E. Coli, which in mammalian cells does not operate through a true recombination process. Another possibility in diploid cells would be the existence of a repair process similar to multiplicity reactivation in phage. Assuming that each chromatid is a single DNA double helix, one should be able to demonstrate not only exchanges between sister chromatids but also exchanges of DNA between chromosomes. Hybrids between ^{3}H and ^{14}C labeled cells were obtained and chromosomes, labeled with one isotope but carrying discrete regions labeled with the other one, have been found suggesting exchanges which might be reciprocal; their frequency is increased by low doses of uv. Evidence that these exchanges take place at the molecular level was obtained by CsCl centrifugation. A tetraploid line of Chinese hamster cells was isolated and submitted to uv radiation; the survival curve is identical to that of either of the parental diploid strains. However this tetraploid strain is about twice as sensitive to caffeine postirradiation treatment. This suggests that a very efficient caffeine sensitive mechanism operates, probably more efficiently, in the tetraploid than in the diploid strains, perhaps to overcome dominant lethal events. These results suggest that the possibility of a true recombination repair mechanism in mammalian cells should not be discarded. (auth)

15779 (EUR-5122(Vol.2), pp 625-653) EXTRAPOLATION NUMBER AND RADIOSENSITIVITY IN THE FRAME WORK OF THE "M TARGETS-ONE HIT" MODEL INCLUDING THE RECOVERY OF THE HIT TARGETS. Abillon, E. (CEN de Saclay, Gif-sur-Yvette, France). Mar 1974. (In French).

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

In the "m targets-one hit" model taking not into account recovery, it is known that the extrapolation number is equal to the number of targets "m" and that the radiosensibility is equal to the hit probability "a" of a target. Considered here is what those two parameters become when the recovery of the hit targets is included in this model. A numerical investigation is made for values of the number of targets $2 \leq m \leq 10$ and it is found that: The extrapolation number is a function of only two parameters, the number of targets m and the ratio α/a of the probability of recovery to the probability of hit. It is possible to approximate the radiosensibility by an expression in the form: $\lambda_1 = a\,B\,e^{-Cm}$ in which B and C are functions depending only on ratio α/a. The values of the extrapolation number and of the ratio λ_1/a are given for different values of $2 \leq m \leq 10$ and of $0 \leq \alpha/a \leq 9$. (auth)

15780 RESULTS OF RADIOBIOLOGICAL EXPERIMENTS ON SATELLITES. Shank, B. B. (Case Western Reserve Univ., Cleveland). pp 313-351 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Data are reviewed from studies of alterations caused by weightlessness on the effects of radiations encountered during space flight in biological specimens carried on satellite missions. The specimens ranged from unicellular organisms (bacteria, amoebae, frog eggs, Neurospora) to plants (wheat seedlings, Tradescantia, bell pepper plants) and insects (Drosophila larvae and adults, Tribolium pupae, and Habrobracon adults). Alterations caused by weightlessness on the effects of radiation were, for the most part, in the form of an enhancement of the radiation effect. This was especially noted in the direct genetic studies. Developmental anomalies in irradiated insects were enhanced by weightlessness. (45 references) (CH)

15781 CELL KINETICS AND RADIATION RECOVERY MODELS. Steward, P. (Washington Univ., St. Louis). pp. 565-582 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Cellular models of radiation injury and recovery fall into two groups: the analytic models (Sacher's division delay, the Von Foerster equation, and the diffusion equation models) and the numerical models (the state vector, the Monte Carlo, and the age transfer models). The analytic models have the advantage of possibly offering some cell behavior in the form of a single formula. However, the analytic models are not versatile when a large number of variable parameters are involved. In this case realistic assumptions rarely permit analytic solution of equations. A numerical solution to the equations must then be found, and the advantage of the analytic model is lost to a large extent. The numerical models, which are designed strictly for computer operation, have the flexibility of permitting any manipulation of the cell population after any one of the clock time increments. Of the numerical models, the age transfer model probably simulates the progression of cells most accurately. If one wishes to reproduce the uncertainties inherent in experiments employing small numbers of cells, the Monte Carlo model becomes the model of choice. (CH)

15782 MUTAGENESIS BY PHOTOACTIVATION OF CHLORPROMAZINE, A TRANQUILIZER OF THE PHENOTHIAZINE GROUP. MacPhee, D. G.; Imray, F. P. (La Trobe Univ., Bundoora, Victoria). Aust. J. Biol. Sci.; 27: No. 2, 231-234(Apr 1974).

The tranquilizer chlorpromazine, in combination with visible light or near-uv radiation, can cause base-pair substitution mutations and frameshift mutations in Salmonella typhimurium. The mutagenic damage is subject to repair by the bacterial excision-repair system. (auth)

15783 RADIOPROTECTIVE EFFECT OF 5-METHOXYTRYPTAMINE ADMINISTERED TO CHINESE HAMSTERS PRIOR TO ACUTE COBALT-60 IRRADIATION. Parzyck, D. C.; King, N. Jr.; Shaw, S. M. (Purdue Univ., Lafayette, IN). Radiochem. Radioanal. Lett.; 17: No. 5-6, 351-358(30 Jun 1974).

Pretreatment with 5-methoxytryptamine did not reduce the number of chromosomal aberrations found in the liver cells of Chinese hamsters exposed to either 825 or 1025 R of ^{60}Co irradiation. An uptake and retention study utilizing tritiated 5-methoxytryptamine showed that the compound and/or metabolites were present in the liver during the critical irradiation period. (auth)

15784 NEURAMINIDASE-INDUCED ENHANCEMENT OF TUMOR GROWTH IN MICE. Froese, G.; Berczi, I.; Sehon, A. H. (Manitoba Cancer Treatment and Research Foundation, Winnipeg). J. Nat. Cancer Inst.; 52: No. 6, 1905-1908(Jun 1974).

B16 melanoma grown in C57BL/6J mice was weakly immunogenic. BCG given with 3×10^6 x-ray-killed tumor cells before implantation of viable tumor cells reduced their growth rate. The presence of cytotoxic lymphocytes was demonstrated in tumor-bearing mice between day 3 and 15 after tumor implantation. Treatment of the x-ray-killed immunizing cells with Vibrio comma neuraminidase resulted in enhanced growth of B16 tumors. (auth)

15785 RADIOSENSITIVITY OF HUMAN ENDOTHELIAL CELLS IN CULTURE. De Gowin, R. L.; Lewis, L. J.; Hoak, J. C.; Mueller, A. L.; Gibson, D. P. (Univ. of Iowa, Iowa City). J. Lab. Clin. Med.; 84: No. 1, 42-48(Jul 1974).

These represent the first studies of the effect of irradiation on replicating human endothelial cells in culture. Deoxyribonucleic acid synthesis and replication of endothelial cells, measured by the uptake of tritiated thymidine and cell counts, were suppressed for at least 2 weeks by a dose of 870 rads. Minimal attrition of endothelial cells from a monolayer culture occurred after irradiation with 1,750 rads. Endothelial cells receiving doses of 870 rads in confluent cultures failed to replicate after passage to a lower cell density, suggesting that radiation had damaged the mitotic apparatus of the resting cells. (auth)

15786 STUDIES ON THE MECHANISM OF INTERACTION BETWEEN LYSERGIC ACID AND CHROMOSOMES. Dorrance, D. L.; Beighlie, D. J.; Yoshii, V.; Janiger, O.; Brodetsky, A. M.; Teplitz, R. L. (City of Hope National Medical Center, Duarte, CA). J. Lab. Clin. Med.; 84: No. 1, 36-41(Jul 1974).

Data are on the effects of pure lysergic acid diethylamide (LSD) at varying concentrations (in vitro) upon chromosome structure and number. In addition, this study explores the effects of the drug upon the ability of cells to repair ultraviolet-damaged DNA. The latter test was based on published data indicating intercalation of LSD into the helix of DNA. Significant changes of chromosomes occurred only at high doses. Neither LSD nor drugs which bound or intercalated into DNA affected the DNA repair process. (auth)

15787 GAMMA-RAY INDUCED THYMINE DAMAGE IN MAMMALIAN CELLS. Roti, F. L.; Cerutti, P. A. (Univ. of Florida, Gainesville). Int. J. Radiat. Biol.; 25: No. 4, 413-417(Apr 1974).

As a measure for the radiation chemical reactivity of thymine in situ, the γ-ray, induced formation of $[^{3}H]H_2O$ was determined from Chinese hamster ovary cells (CHO), labelled in their DNA with thymine-methyl-$[^{3}H]$. Linear dose-response curves were obtained for the ratio of $[^{3}H]H_2O$ formed over T, the acid-insoluble fraction containing 99.7% of the radioactivity of the original sample, in the range 5 to 300 krads. The reaction showed a pronounced oxygen effect. Studies with specific radical scavengers confirmed the expectation that indirect radiation action was mostly responsible for the formation of $[H^{3}]H_2O$. The values for the products of the rates of reaction of the scavengers with OH-radicals times the scavenger concentration affecting 50% suppression of the formation of $[^{3}H]H_2O$ ($M_{\frac{1}{2}}$) were essentially constant for all scavengers. The reactivity was found to be equal in S and M phase and only

slightly lower in the G_2 phase of the cell cycle. It is estimated for aerobic conditions, that 6 molecules of H_2O were formed per cell and rad due to hydrogen abstraction from the thymine-methyl groups by OH-radicals. It is concluded that DNA base damage predominates over strand breakage and the thymine is presumed converted to 5-methylene-uracil. (UK)

15788 STUDIES IN THE GENETICS OF HIGHLY SPECIALIZED CELLS IN CULTURE. I. Hybrids of Animal Cells From Different Vertebrate Classes: Avian Erythrocyte-Mammalian Liver and Kidney Cells. II. Adaptation, Maintenance and Functional Assays of Mouse Plasmacytomas in Cell Culture. III. Immunological Dissection of the Nervous System: Rat and Mouse Neuron X Human Fibroblast Hybrids. Trisler, G. D. Bloomington, IN; Indiana University (1973). 148p. University Microfilms Order No. 74-9445.

Thesis (Ph.D.).

Somatic cell hybrids were made between cells from two vertebrate classes. Chicken erythrocytes were fused with Sendai virus to rat liver (BRL30E) and hamster kidney (BHK) cells. The hybrids contained microchromosomes like those of chickens, but since such microchromosomes may appear in mammalian cell lines they cannot serve as markers for the chicken parent. However, these hybrids contained as much as 5 to 8% chicken DNA as determined by cRNA/DNA hybridization. Starch gel electrophoresis showed that 3 of 44 chicken–hamster hybrid strains synthesized chicken specific and mammalian glucose phosphate isomerase (EC 5.3.1.9) as did 5 of 70 chicken–hamster hybrids. Chicken specific surface antigens were demonstrated on the hybrids 3½ months after fusion. X-irradiation of mammalian parent cells before fusion with erythrocytes did not increase frequency of hybrid cell formation or retention of chicken DNA. Allowing time for the erythrocyte nucleus to reactivate before the mammalian nucleus underwent mitosis in BRL30E/RBC heterokaryons did not increase the incidence of hybrid cell strains nor the retention and expression of chicken DNA. Ten mouse plasma cell tumors were adapted to cell culture. Two of the in vitro plasmacytomas, LPC1 and MC630, were demonstrated by Ouchterlony diffusion to synthesize the same immunoglobulins as the in vivo tumors. One of them, RPC5, synthesized only kappa chains in vitro. The cultures were established from the ascites form of the tumors by placing the fluid in a 1:1 mixture of fresh and cell conditioned medium containing 5% fetal calf serum. The plasmacytomas were maintained by subculturing yogurt style, i.e., starting new cultures with a large portion of medium and cells from an old culture. Growth studies on LPC1 and RPC5 indicated that the cells grew better in conditioned medium than in fresh medium alone. The immunological specificities of particular types of neurons have not been described because it has not been possible to collect individual neurons in quantities and purities sufficient to produce antisera. Large populations of cells originating from a single neuron are now available by means of somatic cell hybridization of normal neurons with dividing fibroblasts. (Diss. Abstr. Int., B)

15789 EFFECT OF BLEOMYCIN AND RADIATION IN COMBINATION ON BACTERIA AND MAMMALIAN CELLS IN CULTURE. Bleehen, N. M.; Gillies, N. E.; Twentyman, P. R. (Middlesex Hospital, London). Brit. J. Radiol.; 47: No. 558, 346-351 (Jun 1974).

Studies were carried out on the effect of bleomycin and radiation in combination on the survival of three bacterial strains and two mammalian cell lines. When the bleomycin was present before and/or during γ-irradiation, the effect of the two agents was merely additive for all the cell types studied. It was found, however, that when E. coli B/r were exposed to bleomycin after irradiation, the decrease in survival was considerably greater than would have been produced merely by addition of the effects of the two agents. Such a decrease was not, however, observed for E. coli Bs-1, Micrococcos radiodurans, EMT6 mouse tumour cells or HeLa cells. The results are discussed with reference to possible clinical significance. (auth)

15790 EVIDENCE OF A SIGNIFICANT ONE-HIT COMPONENT IN THE CELL SURVIVAL CURVE, OBTAINED FROM THE EVALUATION OF CELLULAR RECOVERY AS A FUNCTION OF THE DOSE PER FRACTION. Comparison of Different Endpoints in Mice and Patients. Wambersie, A. (Cancer, Inst., Leuven, Belg.); Gueulette, J.; Dutreix, J. pp 348-362 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Cellular recovery from radiation injury was studied as a function of the dose per fraction using as biological criteria: intestinal death in mice, skin reactions in mice and patients, and tumor regression in patients. The additional dose due to difference in cell repair, D_r, necessary to reach a given biological effect was estimated, when a dose (D_2) is split into two equal subfractions (2 D_1) separated by an interval (i) ($D_r = 2D_1 - D_2$). Variation of D_r as a function of D_1 was found to be similar for the biological systems studied and D_r appears to be very small (≤20 to 30 rads) for doses per fraction D_1 less than 200 rads. Comparison of experimental data and theoretical models of cell survival curves suggests the need for a significant one-hit component ($D_2/D_1 = 0.5-0.7$). Direct lethal events seem to be the main factor in the mechanism of cell killing for doses less than 200 to 300 rads. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 14933, 15741, 15753, 15765, 15768, 15769, 15780, 15789, 15890, 15971, 18083, and 18112.

15791 (CONF-730228-, pp 581-593) GENETIC TRANSFORMATION IN RHIZOBIUM. Peris, P.; Modi, V. V.; Raina, S. L. (Univ. of Baroda, India). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

Rhizobium japonicum and Rhizobium trifoli were transformed for the streptomycin resistance marker with frequency ranging between $10^{-3}-10^{-2}$ and $10^{-4}-10^{-3}$ percent respectively. The development of competence induced in Rhizobium japonicum strain under conditions of biochemical latency was enhanced in the presence of casaminoacids and Mg^{2+} ions. Dark repair was prevalent during the competence phase and the recipient integrated uv-irradiated DNA, the ratio of transformants for unirradiated and irradiated DNA remaining constant for the first 10 sec of irradiation dose. Various endo- and exo-nuclease phenotypes were transformed with almost equal efficiency, besides, the saturating concentration of DNA (5 μg/mg) remained unchanged for the nuclease recipients. Several mutants deficient in dark repair were transformed to frequencies lower than that obtained with the wild type implicating some common step involved in dark repair and integration of the donor DNA. Results indicate that the several steps that occur between uptake and integration of donor DNA may be responsible for the low frequency of transformation. (auth)

15792 (CONF-730228-, pp 627-639) REPAIR OF X-RAY INDUCED DAMAGE IN THYMINE STARVED BACTERIA. Bhattacharjee, S. B. (Saha Inst. of Nuclear Physics, Calcutta). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

In thymine starved E. coli B/r single strand breaks in DNA, produced by x-irradiation were not repairable in 60 minutes of growth, as was observed from alkaline sucrose gradient analysis of the DNA. Thymine starved bacteria were also more susceptible to the production of strand breaks in DNA by x-irradiation. This observation indicated that thymine-starvation of bacteria should increase their subsequent x-ray sensitivity. However, in experiments dealing with the x-ray sensitivity, it was found that thymine starvation increased sensitivity only in the cases where bacteria possessed Hcr^+ characteristics. The experimental results could be explained by postulating that thymine starvation suppressed the activity of Rec gene and that for this suppression, the presence of Hcr^+ gene was necessary. (auth)

15793 (CONF-730228-, pp 641-652) REPAIR OF UV-DAMAGE IN SINGLE STRANDED DNA: DIFFERENT ROLES OF UVR AND REC SYSTEMS OF E. COLI IN UV REACTIVATION OF PHAGE φX174. Dasgupta, C.; Poddar, R. K. (Saha Inst. of Nuclear Physics, Calcutta). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

Ultraviolet reactivation is the increased survival of a uv-irradiated phage population as a result of pre-irradiation of the host cells. The extent of this repair phenomenon was investigated in bacteriophage, φX174 and the influence of various enzymatic reactions of the host cells on such repair, the special point of interest being the single-strandedness of φX-DNA which is unable to act as a template for the well known excision repair mechanism. It was observed that for maximum amount of reactivation, the necessary radiation dose on the phage was constant (approximately 1000 ergs/mm² at 254 μ) for different bacterial strains while the doses on the host cells varied between 100 to 500 ergs/mm², depending on their genetic make up. In the case of uvr (excision-defective) strains, a dose of 100 ergs/mm² enabled them to give a maximum reactivation factor of 4, while there was no reactivation with rec (recombination-deficient) strains for any dose, high or low. (auth)

15794 (COO-3232-3) MOLECULAR BASIS FOR THE MUTAGENIC AND LETHAL EFFECTS OF ULTRAVIOLET IRRADIATION. Progress Report, October 4, 1973–May 29, 1974. Gross-

man, L. (Brandeis Univ., Waltham, Mass. (USA)). 1974. Contract AT(11-1)-3232. 11p. Dep. NTIS $4.00.

Progress is reported on the following research projects: isolation of endonucleases specific for uv-irradiated DNA from Micrococcus luteus and Escherichia coli; biological assay for in vitro repair of DNA; reinsertion of nucleotides into DNA strands; and biochemical repair of uv-irradiated Bacillus subtilis transforming DNA. (HLW)

15795 (EUR-5122(Vol.2), pp 1071-1087) BIOLOGICAL EFFECTS OF INDIVIDUAL HZE PARTICLES IN THE BIOSTACK EXPERIMENT. Buecker, H.; Horneck, G.; Hildebrand, D. (Univ. Frankfurt am Main, Ger.). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

The BIOSTACK experiment, which was flown on board the command modules of Apollo 16 and 17, was composed of a series of monolayers of biological objects in resting state (bacterial spores, plant seeds, animal eggs) with each layer sandwiched between visual track detectors (nuclear emulsions, cellulose nitrate and polycarbonate sheets, and AgCl-crystals). During flight each biological layer was in fixed contact with a track detector sheet. Specially developed methods allowed to determine each biological object which was hit by a heavy ion of cosmic radiation as well as the charge and energy of that particle. Of special interest were the very heavy ions of high energy (HZE-particles) with high energy loss on their trajectory through material. Thus it was achieved in the BIOSTACK experiment, to identify each penetrating HZE-particle in correlation with the possible biological effects on its path. A widespread spectrum of biological response to the penetration of an HZE-particle was observed. (auth)

15796 (RLO-2225-T-15-19) REPAIR OF RNA. Gordon, M. P. (Washington Univ., Seattle (USA). Dept. of Biochemistry). 1974. 10p. (CONF-740231-3). Dep. NTIS $4.00.

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

Progress is reported on studies of photorepair mechanisms active on RNA in uv-irradiated plant viruses; the photoreactivation of uv-irradiated TMV-RNA on white leaves of a variegated mutant host which lacked chlorophyll; the ability of xanthi plants to photoreactivate uv-killed TMV-RNA as a function of light color and intensity; and the in vitro photoreactivation of TMV-RNA in cell-free extracts of tobacco plants. (CH)

15797 STATISTICAL ESTIMATION OF 12D FOR RADAPPERTIZED FOODS. Ross, E. W. Sr. (Army Natick Labs., MA). J. Food Sci.; 39: No. 4, 800-806(1974).

A new mathematical analysis of the inoculated pack method for determining the effectiveness of radappertization (radiation-sterilization) of canned food is presented. A general theory is developed which makes it clear that two interrelated distribution functions, the probability of organism death and the probability of can sterilization, play important parts in the process. A critique is given of the Schmidt-Nank method for calculating the 12D dose, and modifications of both the experimental design and data analysis are suggested. Two examples are worked out, one illustrating the use of the suggested method, the other using the theory and an experiment on canned ham to show that the mode of organism death is unlikely to be exponential. (auth)

15798 TRANSFECTION OF BACILLUS SUBTILIS WITH BACTERIOPHAGE H1 DNA: FATE OF TRANSFECTING DNA AND TRANSFECTION ENHANCEMENT IN B. SUBTILIS UVR^+ AND UVR^- STRAINS. Arwert, F.; Venema, G. (Univ., Groningen, Netherlands). Mol. Gen. Genet.; 128: No. 1, 55-72(Jan 1974).

H1 is a newly isolated virulent Bacillus subtilis bacteriophage. Its DNA is double-stranded, contains 5-hydroxymethyluracil instead of thymine and has a molecular weight of 83×10^6. Transfection of B. subtilis with bacteriophage H1 DNA requires the cooperation of 4 to 5 H1 DNA molecules. Contrary to transfection enhancement effected by exposing competent cells to uv-irradiated homologous or heterologous DNA, enhancement by uv-irradiation of the competent cells requires that the cells are capable of carrying out the incision step in the excision-repair process of removal of uv-damage. Irreversibly absorbed H1 DNA is double-stranded, has suffered endonucleolytic degradation and is subject to exonucleolytic attack. The observations that the amount of endonucleolytic damage is equal in normal and transfection enhancing conditions, and that exonucleolytic degradation is inhibited in enhancing conditions suggest that transfection enhancement is caused by protection from exonucleolytic activity, which is considered to be trapped by uv-irradiated DNA. (auth)

15799 EFFECT OF LEX ON UV SENSITIVITY, FILAMENT FORMATION, AND LAMBDA INDUCTION IN LON MUTANTS OF ESCHERICHIA COLI. Donch, J. J.; Greenberg, J. (Palo Alto Medical Research Foundation, CA). Mol. Gen. Genet.; 128: No. 4, 277-281(Feb 1974).

The lex mutation was transduced into strains K 12 lon and B (lon). Survival after uv was identical with that of isogenic exr A strains. Lex like exr A suppressed uv-induced filament formation without affecting the mucopolysaccharide production of K 12 lon strains. Lex mutants were found to suppress spontaneous and uv induction of lambda prophage. The kinetics of suppression were similar to those described for the exr A (lambda) mutant. The conclusion is that lex and exr A probably represent mutations within the same cistron. (auth)

15800 GENETIC EVIDENCE OF THE DETACHMENT OF PROPHAGE LAMBDA FROM THE CHROMOSOME OF BACTERIA OF A LYSOGENIC DONOR STRAIN AFTER INDUCTION BY ULTRAVIOLET IRRADIATION. Belokrysenko, S. S. (Moscow Medical Inst.). Sov. Genet. (Engl. Transl.); 7: No. 5, 649-654(May 1971).

Translated from Genetika; 7: No. 5, 123-129(May 1971).

This work was devoted to the genetic demonstration of the detachment of prophage λ from the chromosome of bacteria of a lysogenic donor strain after induction by uv irradiation. It was established that uv irradiation of the lysogenic donor strain E. coli K1 (λ) with a dose causing the induction of 98 to 99% of the cells results in a three- to fourfold decrease in the frequency of transfer of prophage λ by the recombinant that received the first marker gal. In a cross of a lysogenic recipient with a lysogenic donor, irradiated with an inducing dose of uv, in certain cases segregation of the character of lysogeny and the appearance of nonlysogenic recombinant individuals were detected. When a nonirradiated lysogenic donor was used in an analogous cross, all the recombinant colonies contained only lysogenic bacteria. The frequency of transfer of the bacterial marker trp, distal to the prophage, by the lysogenic donor after induction with uv irradiation was reduced substantially more than for the nonlysogenic donor, irradiated with the same dose of uv. The peculiarities of the transfer of prophage λ and the bacterial markers studied to the donor strain E. coli K1 (λ) demonstrate the existence of lysogenic cells in the population 30 to 40 min after irradiation of bacteria with various interrelationships between prophage and the bacterial chromosome with an inducing dose of uv. Together with the initial lysogenic cells, the population contained individuals with a break in the chromosome between the markers gal and trp after the cutting out of prophage λ, as well as bacteria that restored the continuity of the chromosome in the absence of the prophage and behaved in a cross as nonlysogenic donors. Under the conditions of the experiment, most of the bacteria retained the break in the bacterial chromosome 30 to 40 min after induction. (auth)

15801 MODIFICATION OF THE WATER-DEPENDENT RADIATION SENSITIVITY OF BACTERIAL SPORES BY INERT GASES. Kimler, B. F. Austin, TX; Univ. of Texas (1973). 135p. University Microfilms Order No. 74-5266.

Thesis (Ph. D.).

Spores of Bacillus megaterium were x-irradiated under conditions of controlled water content and in the presence of various inert gases. While spores irradiated anoxically in nitrogen exhibit straight-line, semi-log survival curves, spores irradiated in argon, krypton, or xenon show a biphasic survival curve with a low dose component that is more sensitive than the corresponding irradiation in nitrogen and a high dose component that is less sensitive than in nitrogen. There is a consistent correlation between the ability of the gas to structure water and the degree of sensitization brought about by the inert gas. This has been used to strengthen a model of water-dependent radiation sensitivity in the spore. There are three compartments of water in the spore: a region of water so strongly associated with the sensitive target molecules (probably DNA) that it can not be removed or replaced even under extreme conditions, a hydration sheath approximately two water molecules thick around the macromolecule and held as "bound" water by the macromolecule, and the volume of water outside the influence of the macromolecule and its hydration sheath which acts as unassociated cytoplasmic water. Radiation-induced damage in the spore is mediated by the transfer of energy through the first two regions and possibly by the formation of radiolytic species in the latter two regions. The modification of the radiation response by inert gases is seen as an increase in the structure of water in the first two regions. This will promote a more efficient transfer of energy to the sensitive sites within the spore. However, this increase in sensitivity only exists until a sufficient dose has been given to break down this additional structure. After the breakpoint the spores will display a more resistant radiation sensitivity as indicated by the second component of the biphasic survival curve. Thus, the radiation sensitivity of a bacterial spore is

a function of the degree of structure that exists in the water within the spore. (Diss. Abstr. Int., B)

15802 PROCEEDINGS OF THE UNITED STATES PHARMACOPEIA CONFERENCE ON RADIATION STERILIZATION HELD IN WASHINGTON, DC, OCTOBER 9–10, 1972. International Journal of Radiation Sterilization, Volume 1. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973). 228p. (CONF-7210119-).

Separate abstracts were prepared for the 15 papers presented in these proceedings. (ERB)

For abstracts of individual papers see: 15803–15817.

15803 PRESENT STATUS OF RADIATION STERILIZATION TECHNOLOGY AND EXPERIENCE. Artandi, C. (Ethicon, Inc., Somerville, NJ). pp 9-19 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The first radiation-sterilized products appeared on the market in the early fifties. During the next 18 to 20 years, irradiation became well established for the sterilization of single-use medical products, implants and surgical adjuncts. The relatively rapid success and acceptance of the process has been due to the fact that it filled a real need at the time when single-use medical products began to revolutionize patient care. Radiation sterilization is a simple and extremely reliable process though not universally applicable, just as in the case of other sterilization methods. While machine sources (electron accelerators) were used initially, radioisotopes gradually became the preeminent radiation sources. At present, there are twenty-nine commercial radiation plants being used for sterilization of medical products around the world, without counting radiation facilities for research and development purposes or for some custom irradiation. The largest volume application is related to single-use medical products. Drugs have not yet been radiation-sterilized to any significant degree, partly because of deleterious radiation effects and partly because of complex governmental regulatory control. Food sterilization and preservation did not fulfill the originally anticipated great potential. The reasons are related to lack of commercial interest in this new process by the food industry, as well as to the great expense involved in providing proof of safety and wholesomeness of irradiated foods. The future of radiation sterilization looks very bright, particularly the continued growth of its use in the health care industry. (auth)

15804 SOURCES AND FACILITIES FOR RADIATION STERILIZATION OF MEDICAL SUPPLIES. Ballantine, D. S. (Atomic Energy Commission, Washington, DC). pp 21-44 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The different types of radioisotope sources and radioisotope facilities are described considering continuous-automatic versus batch facilities, provisions for expansion and plant efficiency. High energy electron accelerator facilities for radiation sterilization are considered in comparison to gamma facilities, discussing absorption efficiency, rate of energy absorption, and product heating. The technological and economical parameters of isotope and accelerator facilities are compared presenting several conclusions. The availability of radiation service facilities in the U. S. is discussed. (auth)

15805 EFFECT OF RADIATIONS ON MICRO-ORGANISMS. Idziak, E. S. (McGill Univ., Ste. Anne-de-Bellevue, Quebec). pp 45-59 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The effects of radiation on microbial cells are discussed considering alterations in DNA structure, repair of damage on irradiated DNA, effects of the irradiation medium and conditions on cell survival, and post-irradiation behavior of cells. This description of the physical-chemical reactions, at the molecular level, between components of the microbial cell and the radiation energy allowed evaluation of the potential microbial hazards associated with irradiation processing. After a brief consideration of the first category of processing-radappertization, where total destruction of microflora is achieved, detailed attention is given to the two categories — radurization and radicidation where survivors are expected. Here five types of microbiological hazards are considered: increased radiation resistance, increased pathogenicity, increased toxicity, altered biochemical characteristics, and resistance to antibiotics. It is concluded that the data presented give no indication of microbiological hazards associated with irradiation processing. (auth)

15806 FACTORS ASSOCIATED WITH SAFETY AND EFFICACY OF STERILIZING PROCEDURES. Bruch, C. W. pp 65-70 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The safety and efficacy of a medical item are affected by the choice of sterilizing agent. The basic issue with efficacy is that the product meet certain performance standards (potency and stability with pharmaceuticals) following sterilization. Drugs that require a NDA before marketing are reviewed for the possibility of an effect of the sterilizing process on drug potency and quality. With medical devices the burden of proof for efficacy before marketing rests with the manufacturer since preclearance is not required. The basic safety issue is that the product be sterile and non-toxic following sterilization. The sterility tests described in the drug compendia (USP and National Formulary) are considered to be minimal requirements to be met before an item is marketed. The only sterilant for which a legal mandate exists to prove nontoxicity is ionizing radiation applied to drugs. No governmental standards exist for the presence of ETO residues in medical products, but the Z-79 Subcommittee of ANSI is in the process of publishing interim guidelines for such residues in plastic materials and devices. (auth)

15807 PROCESS PARAMETER CONTROL, DOSIMETRY, AND OPERATION IN RADIATION STERILIZATION PROCESSING. Relative Merits of Cobalt-60 and Linear Accelerator Plants. Holm, N. W. (Danish Atomic Energy Commission Research Establishment, Risoe). pp 71-84 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The objectives of process parameter control and dosimetry in radiation sterilization processing are discussed with a view to IAEA's Recommended Code of Practice for Radiation Sterilization of Medical Products. It is concluded that, like so many conventional industrial processes, the radiation sterilization process can be controlled purely in terms of physical process parameters once the microbicidal efficiency as function of the process parameters has been established. Methods for dosimetry and process control are described and the relative merits of ^{60}Co-plants and linear accelerator plants are discussed. (auth)

15808 ASPECTS OF MICROBIOLOGICAL CONTROL OF RADIATION STERILIZATION. Tallentire, A. (Univ. of Manchester, UK). pp 85-103 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The methods of microbiological control that relate to the actual sterilization stage of manufacture of irradiation sterilized products are considered. Attention is given to the value, use, and problems in the design of biological indicators for diverse sterilization processes, with particular stress on radiosterilization, and to the assessment of the feasibility of a new method of control based on tests performed on production items irradiated with doses that are less than that used in the sterilization treatment. Consideration is given to the possible use of fractions of the radiation processing dose in testing for effectiveness and theoretical evaluations of the effect of sub-process radiation dose treatments are presented. The practical application of the sub-process dose technique is considered in some detail. (auth)

15809 EXPLOITATION OF THE PROPERTIES OF GAMMA RADIATION IN STERILIZATION PRACTICE. Ley, F. J. (Irradiated Products Ltd., Swindon, UK). pp 105-118 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

Prevention of the infection of patients through the use of sterile products requires close examination at an early stage in product design. Production itself requires hygienic conditions, packaging must be bacteria proof and convenient to open, unavoided contaminants require inactivation and a microbiological quality control procedure should be practiced. The impact of the properties of gamma-radiation in these areas is examined and some practical applications that illustrate the scope of the subject of sterilization are described. (auth)

15810 EFFECTS OF RADIATION ON SOME MEDICAL DEVICES. Petterson, D. R. (Johnson and Johnson, New Brunswick, NJ). pp 119-132 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

Some of the technical problems involved with some materials used in radiosterilized medical items are discussed. The changeover from polystyrene to polypropylene as material for disposable hypodermic syringes was hampered initially by deterioration phenomena discovered after ageing radiosterilized syringes for 30 days at 120°C. These were eliminated by reformulating the raw material, as demonstrated by tests performed according to two methods, one qualitative and one quantitative, in which flange strength was measured after room temperature ageing. A mechanism based on free radical formation and their scavenging by the stabilizer system is proposed. Studies of the effect of radiation on cellulose materials demonstrated slight color changes, their intensity being proportional to the dose and inversely proportional to the moisture content, as well as slight losses in tensile strength, proportional to dose but little affected by dose rate and moisture content. The possible mechanism is considered after demonstrating experimentally two stable radicals in irradiated cellulose. (auth)

15811 INACTIVATION OF BACTERIAL SPORES BY COMBINATION PROCESSES: ULTRAVIOLET PLUS GAMMA RADIATION. Grecz, N.; Durban, E. (Illinois Inst. of Tech., Chicago). pp 137-161 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

Bacterial spores, viruses, and some vegetative bacteria such as Streptococcus faecium and Micrococcus radiodurans are distinguished by high radiation resistance. Their irradiation often requires severe radiation treatment. This may impair the desirable qualities of biomedical devices, i.e. reduce tensile strength and flexibility, change color and texture, induce toxicity. High radiation doses may also reduce potency of drugs and biologicals or even alter their chemical structure. The advantages of combination treatments for selective inactivation of bacterial contaminants are receiving increased consideration, including combinations of temperature plus radiation, chemicals plus radiation, ultraviolet plus gamma radiations. In order to lay a theoretical basis for biomedical sterilization applications, we have investigated the combined action of uv and gamma rays. Spores of two strains of C. botulinum were selected, a highly radiation resistant strain, 33A having a D_{10}-value of 0.32 Mrad, and a relatively radiation sensitive strain, 51B having a D_{10}-value of 0.12 Mrad. Strain 33A exhibits an extensive initial shoulder in its uv as well as gamma ray survival curves; strain 51B shows only a slight shoulder. The shoulder in the gamma ray survival curve of spores of strain 33A could be reduced or completely eliminated by preirradiation with uv. Simultaneously the D_{10}-value for gamma inactivation of spores of 33A was reduced substantially. For example, the gamma resistance was reduced almost to half of its original D_{10}-value by uv-preirradiation for only one minute under an 8 watt GE germicidal lamp. The effect of uv-preirradiation on the radiation sensitive strain 51B was less pronounced. In fact, there was about seven fold higher positive interaction (synergism) between uv and gamma radiation in 33A spores than in 51B spores. The experiments suggest that interference with DNA repair enzymes in the radiation resistant strain are responsible for lethal synergism between uv and gamma radiation. A hypothesis is developed attempting to explain the combined effect of these two radiations in terms of a special summation of known DNA lesions in the cell. These observations emphasize the potential practical advantages of combining uv and gamma rays for effective sterilization of certain biomedical devices, drugs, and biologicals. (auth)

15812 BACTERIAL SPORES AS POSSIBLE CONTAMINANTS OF BIOMEDICAL MATERIALS AND DEVICES. Grecz, N.; Kang, T. (Illinois Inst. of Tech., Chicago). pp 163-176 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

Destruction of spores on biomedical devices, in drugs, and biologicals is essential for prevention of infection of patients with pathogenic sporeformers. Of particular concern are Clostridium tetani, C. perfringens, C. botulinum, Bacillus anthracis, and other sporeforming pathogens. Spores are ubiquitous in nature and contamination of biomedical devices varies depending on manufacturing process, handling, raw materials, and other variables. In the last 20 years the number of cases per year of specific notifiable diseases in the United States was as follows: tetanus, 120 to 500 cases, botulism, 7 to 47 cases, and anthrax, 2 to 10 cases. Gas gangrene is caused by a mixed flora consisting predominantly of sporeformers. C. botulinum, which usually acts as saprophytic agent of food poisoning, may also initiate pathogenic processes; there are nine cases on record in the United States of botulism wound infections almost half of which ended in death. The spores of these organisms are distinguished by high radiation resistance and their erradication often requires severe radiation treatments. Representative bacterial spores in various suspending media show D_{10} values (dose necessary to destroy 90% of a given population) ranging from approximately 0.1 to 0.4 Mrad. Some viruses show D_{10} values up to >1 Mrad. The D_{10}-values of spores vary depending on physical, chemical, and biological factors. This variability is important in evaluation and selection of biological indicator organisms. Radiation sterilization of biomedical devices and biomedical materials must provide safety from infectious microorganisms including radiation resistant spores and viruses. (auth)

15813 EXPERIENCES IN THE STERILIZATION OF DEVICES FOR MEDICAL USE. Bruck, S. D. (National Institutes of Health, Bethesda, MD). pp 177-196 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

Various medical devices and implants in contact with blood are partially or totally constructed from synthetic materials the mechanical performance and/or blood compatibility of which can be adversely affected by particular sterilization techniques. Therefore, it is necessary to consider each system separately with attention to both physico-chemical parameters (such as glass transition temperature, melting point, functional groups, morphological and surface changes, degradation products) and biological parameters (such as blood compatibility and toxicity). The relative merits of various sterilization techniques are discussed, including radiation, cold plasma gas, and steam. (auth)

15814 PRODUCER-SERVICER. Stein, M. H. (Radiation Service Associates, Inc., Dover, NJ). pp 197-200 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The high initial investment in radiation sterilization plants discourages many producers investigating the applicability of this method to their products. The radiation service companies have been formed to alleviate the problems of producers by providing sterilization services to many manufacturing companies on a service contract basis. These firms also provide consultation on radiation suitability based on considerable experience in treatment of diverse products including advice on safety testing, manufacturing and packaging products, sterility testing, radiation dosage, efficacy, dosimetry, economics, and regulatory requirements, and ultimately may provide irradiation equipment or a facility when economically justified. Strong cooperation between producer and service companies is advocated to ensure correct decision upon consideration of the suitable sterilization method. (auth)

15815 U. S. PHARMACOPEIA AND RADIATION STERILIZATION. Kronenwett, F. R. pp 201-204 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

Seven points contained in the section on Penetrating Radiation for the Sterilization of Medical Products in the general chapter on sterilization of the current edition of the Pharmacopeia, U. S. P. XVIII, and relating to the discussions during this conference, are presented and discussed. Considered are the presterilization microbiological contamination, generally accepted dose, dosimetric techniques, machine or isotope sources, and biological indicators for sterility testing. Sterility testing and toxicity testing are discussed in this reference. The data presented at the conference as well as data of collaborative studies on biological indicators will be incorporated in the consideration of the Advisory Panels on Biological Indicators and on Microbiological Attributes, for presentation to the Revision Committee of U. S. P. XIX. In conclusion the importance of assurance of sterility and of adequate process control is stressed. (auth)

15816 FOOD AND DRUG ADMINISTRATION AND RADIATION STERILIZATION. Link, D. (Office of Medical Devices, Rock-

ville, MD). pp 205-208 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

The attitude of FDA to sterilization of medical devices is discussed stressing that no preclearance of devices is required when the method of sterilization is changed. The device industry is essentially free to adopt whatever procedures it may see fit. The concerns of FDA with radiation sterilization as with other forms of sterilization are: that no deleterious or toxic residual by-products be formed, that any changes in physical or other characteristics of the material being treated be investigated, and that the product be shown to be adequately sterilized (i.e. satisfactory process and product control). Steps to be taken by FDA in case of process or product failure are mentioned. Two voids not discussed at the conference are comparisons between methods of sterilization and outlines of the characteristics rendering products particularly suitable to radiation sterilization. (auth)

15817 MANUFACTURER-CONSUMER VIEWPOINT. Miller, W. S. (Becton, Dickinson and Co., Research Triangle Park, NC). pp 209-218 of Proceedings of the United States Pharmacopeia Conference on Radiation Sterilization. Tel-Aviv, Israel; Jacob Slinim Publishing Ltd. (1973).

From conference on radiation sterilization; Washington, District of Columbia, USA (9 Oct 1972). See CONF-7210119-.

Several aspects of radiation sterilization that are of interest to the manufacturer only, and several which are of common interest to both the manufacturer and the consumer are considered. Amongst the former are process economics (comparisons) and regulatory requirements (or guidelines), which being interrelated do suggest close cooperation between regulatory agencies and manufacturer to the ultimate benefit of the consumer. Amongst the latter aspects are: effects of radiation on materials and product functioning, assurance of sterility, types of products that can be processed by this method of sterilization, safety of treatment, and efficacy of process control. The unique potential of irradiation for cold sterilization of hermetically sealed items and the exceptional degree of assurance of sterility at minimal degree of process control are pointed out. Finally, the finances of radiation and ethylene oxide sterilization are compared, demonstrating the economic feasibility of the former process. (auth)

15818 GENETIC TRANSFORMATION OF THE PHAGE T4rIIB BY DNA OF THE PHAGE T4r$^+$. XIII. Minimal Length of DNA Parts Required for Integration of the Donor Fragments in Phage T4 Transformation. Aleksandrov, N. M. (Inst. of General Genetics, Moscow). Sov. Genet. (Engl. Transl.); 7: No. 5, 684-686(May 1971).

Translated from Genetica; 7: No. 5, 166-168(May 1971).

The minimal length of the parts of transforming phage T4r$^+$ DNA required for recombination with the recipient molecules was determined. They were shown to be about 120 to 450 nucleotides. The experiment was based on the use of the phenomenon of an additive effect of uv irradiation and DNAase upon the transforming DNA. It may be assumed that requirements differ for the process of recognition of the recombining DNA molecules and that of their synapsis. (auth)

15819 PRESERVATION OF KAMABOKO BY ELECTRON IRRADIATION. Kitamura, T. (Public Health School of Osaka Prefecture, Japan); Ueno, T. Eiyo To Shokuryo; 25: No. 5, 369-375(Jul 1972). (In Japanese).

The effect of electron irradiation on the preservation of steamed kamaboko (a kind of fish paste products) was studied over a range of doses from 300 to 1,000 krads. The steamed kamaboko used in the study contained 0.2 mg furylfuramide [2-(2-furyl)-3-(5-nitro-2-furyl)-acrylamide] per kg of the food as a food preservative. Steamed kamaboko was packed with cellophane and irradiated by a 5 MeV electrons from a linear accelerator at room temperature. The maximum ionization density in steamed kamaboko treated with the above electrons was observed at a depth of 7mm from the surface. Therefore, it seemed that the electron irradiation by an energy of 5 MeV was suitable for sterilizing the surface. From the results of organoleptic tests (odor, discoloration, mucilage and mould), and of determinations of bacterial number and acidity, 500 krad was selected as a suitable dose for the food preservation. Retardation of spoilage and prolongation of storage life were observed on the irradiated kamaboko; the storage lives of the unirradiated one were 10 days at 8°C, 5 days at 20°C and 2 days at 28°C, but in the case of irradiation 25 days at 8°C, 10 days at 20°C and 4 days at 28°C, respectively. (auth)

15820 PRESERVATION OF ATSUYAKI BY ELECTRON IRRADIATION. Ueno, T. (Radiation Center of Osaka Prefecture, Sakai, Japan); Kitamura, T. Eiyo To Shokuryo; 25: No. 5, 376-379(Jul 1972). (In Japanese).

The effect of electron irradiation on the retardation of spoilage of atsuyaki (a kind of fish paste product) was studied over a range of doses from 300 to 1,000 krads. Atsuyaki was packed with dampproof cellophane and irradiated by 5 MeV electrons from a linear accelerator at room temperature. From the results of organoleptic tests (odor, taste, discoloration, mucilage, and mould), the range of 400 to 500 krads was selected as a suitable dose for the preservation of atsuyaki. The prolongation of storage life of the irradiated samples by an electron irradiation dose of 500 krad also was observed at low temperatures above freezing. The control atsuyaki became mouldy, sticky, and unacceptable in about 3 days at 28°C, whereas irradiated atsuyaki that received 500 krad developed no detectable change other than some acidification and fading. The preservation of irradiated atsuyaki at low temperatures was quite effective in extending the storage life; the extension periods of storage life of the irradiated samples were 2 days at 28°C, 18 days at 20°C, 21 days at 8°C, and more than 35 days at 1°C, respectively. (auth)

15821 IRRADIATION TREATMENT OF ENZYME PREPARATIONS. I. Radiosterilization of Amylase Preparations. Kawashima, K.; Nango, Y.; Doi, T.; Umeda, K. (National Food Research Inst., Tokyo). Nippon Shokuhin Kogyo Gakkaishi; 20: No. 1, 9-15(Jan 1973). (In Japanese).

Various amylase preparations for food processing were radiosterilized with ^{60}Co. The number of microorganisms contaminating the commercial amylase preparations was in most cases less than 10^5 to 10^6/g. By radiation treatment of 0.75 to 1.0 Mrad, a three to four log reduction of microorganisms was achieved. Thus the microorganisms in the commercial amylase preparations will be reduced to less than 10^2/g with the dose of 0.75 to 1.0 Mrad. The moisture content of amylase preparations had little influence on the radioresistance of the enzyme. The residual enzymic activities after the radiosterilization (0.75 to 1 Mrad) of ten amylase preparations were, a) more than 90% (seven amylase preparations); b) about 80% (two); or c) about 70% (one). The thermal stability of irradiated enzymes was not different from that of unirradiated ones. After two months storage of irradiated enzymes at 5 to 10°C, amylase activities were, a) not changed; b) decreased at low dose levels (0.25 to 0.75 Mrad); c) decreased at all the dose levels (0.25 to 2.0 Mrad). Amylase A-10 showed potential damage at low dose level, which appeared after heat treatment or two months storage. The time course of enzyme reaction showed that irradiated enzyme achieved the same degree of hydrolysis. (auth)

15822 RADIOSENSITIZATION OF ANOXIC ESCHERICHIA COLI MUTANTS BY DIAMIDE. Goldstein, L. S.; Harris, J. W. (Univ. of California, San Francisco). Int. J. Radiat. Biol.; 25: No. 4, 391-397(Apr 1974).

The glutathione oxidant, diazenedicarboxylic acid bis(N,N'-diethylamide) (diamide), sensitized anoxic, but not euoxic cells of several repair-deficient strains of Escherichia coli, but some strains were sensitized to a lesser extent than others. The degree to which each mutant was sensitized did not correlate in any obvious way with its oxygen enhancement ratio (oer) or with the absence of specific repair functions. Intracellular non-protein sulfhydryl (NPSH) content of each strain was also unrelated to the oer. Since the extent of NPSH oxidation by diamide was the same for all the strains, it did not account for the different degrees of sensitization. These results indicate that, at the level of cellular DNA, diamide enhances the effective yield of lethal lesions (e.g., strand breaks) and that the mechanism of action is at least partly different from that of oxygen. (auth)

15823 MECHANISM OF SENSITIZATION OF LIVING CELLS TOWARDS IONIZING RADIATION BY OXYGEN AND OTHER SENSITIZERS. van Hemmen, J. J.; Meuling, W. J. A.; van der Schans, G. P.; Bleichrodt, J. F. (Rijksverdedigingsorganisatie TNO, Rijswijk, Netherlands). Int. J. Radiat. Biol.; 25: No. 4, 399-402(Apr 1974).

Experiments were made on the radiosensitivity of PM2 phage DNA suspended in an extract of E. coli C in the presence of O_2, PNAP or TAN. Irradiation of PM2 DNA in the presence of 67 mM $K_4Fe(CN)_6$ and 67 mM $K_3Fe(CN)_6$ and 67 mM $K_3Fe(CN)_6$, where the scavenging efficiency of D_{37} = 100 krads was higher than that of the bacterial extract (D_{37} = 45 krads under N_2) did not result in conditions where O_2 increased the sensitivity of DNA. It is suggested that sensitization by scavenging of water radicals is not the complete explanation and that the results suggest that the extract of E. coli C contained components involved in the radiation-induced inactivation of DNA and that sensitizers influence the reaction of radiation products of these components with DNA. Similar effects were obtained with extracts of human Hep 2 cells and Pseudomonas BAL 31. (UK)

15824 KINETICS OF THE PHENOTYPIC EXPRESSION OF MUTATIONS FOR STREPTOMYCIN RESISTANCE INDUCED BY METHYLMETHANE SULFONATE, N-METHYL-N'-NITRO-N-

NITROSOGUANIDINE, AND ULTRAVIOLET LIGHT IN ESCHERICHIA COLI K-12. Smirnov, G. B.; Favorskaya, Yu. N. (Inst. of Epidemiology and Microbiology, Moscow). Sov. Genet. (Engl. Transl.); 7: No. 5, 664-668(May 1971).

Translated from Genetika; 7: No. 5, 142-148(May 1971).

Complete phenotypic expression of mutations for streptomycin resistance (Sm^r) induced by MMS, NG, and uv occurs after several mitotic cycles in the mutagen-treated cells. Some induced Sm^r mutations are phenotypically expressed before the first mitosis after treatment with MMS or at the time of the first mitosis after treatment with MMS or at the time of the first mitosis after treatment with NG or UV. Reinstatement of DNA synthesis after treatment with a mutagen is a necessary condition for phenotypic expression of induced Sm^r mutations. (auth)

15825 IONIZING RADIATION EFFECT ON DRUGS. Ryabykh, L. D.; Chakchir, B. A.; Grachev, S. A. Voenno-Med. Zh.; No. 11, 84-86(Nov 1973). (In Russian).

Because of the wide bactericidal use of radiation for sterilization, processes occurring in medicines due to irradiation were studied since even insignificant chemical and physical changes may affect the biological activity and toxicological properties of preparations. The sensitivity of therapeutic preparations as a function of their chemical formulas, and the effect of radiation on dry steroid hormones and vitamins (in connection with preservation of food products), on alkaloids, and on diluent for aqueous solution of chemicals are discussed. Data on the action of radiation on local anesthetics and antibiotics are considered. (tr-auth)

15826 POSSIBLE TOXICITY OF POTATOES IRRADIATED BY A FLUX OF FAST ELECTRONS AND BY γ-RADIATION TO RETARD SPROUTING. Shillinger, Yu. I.; Kamal'dinova, Z. M. (Lab. for the Hygienic Studies of Food Additives, Moscow). Vop. Pitan.; No. 6, 50-55(1973). (In Russian).

Irradiating potatoes may result in the production of mutations in organisms that eat them. In order to test this hypothesis potatoes irradiated with a dose of 30 kilorads and 20 kilorads of fast electrons were fed to white rats and the results analyzed by a dominant lethal mutations method. A mutation index is calculated reflecting the presence of mutation of dominant traits. A general mortality rate is also calculated. An examination of a number of these indicators and others relative to the number, viability and genetic mutations indicated that in neither case could genetic damage be documented. (JPRS)

15827 RELEASE OF A DEOXYRIBONUCLEIC ACID FRAGMENT AFTER X-IRRADIATION OF MICROCOCCUS RADIODURANS. Vukovic-Nagy, B.; Fox, B. W.; Fox, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 25: No. 4, 329-337(Apr 1974).

The nature of the ^3H activity released from M. radiodurans after x-ray doses of 500 krads, which cause no decrease in cellular viability, was investigated by gel filtration and alkaline sucrose-gradient centrifugation. Immediately after irradiation, oligonucleotides $\sim 7.0 \times 10^5$ daltons were released which were subsequently rapidly degraded in broth to thymine by exonucleolytic enzymes. Such enzymes were also capable of degrading mammalian DNA. Treatment with iodoacetamide 2×10^{-3}M resulted in a sensitization expressed as a loss of the shoulder of the dose-response curve. The study of DNA degradation products in M. radiodurans treated with iodoacetamide suggested that sensitization was due to inhibition of an enzyme which excised DNA from a DNA-membrane complex. Iodoacetamide appeared not to inhibit the removal of thymine from irradiated DNA. It is suggested that at least two enzymes are involved in the repair of x-ray damage in M. radiodurans and that repair of the DNA-membrane complex is mainly responsible for radioresistance in these bacteria. (auth)

15828 RADIOPROTECTION OF ACHOLEPLASMA LAIDLAWII B BY CYSTEINE. Petkau, A.; Chelack, W. S. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Biol.; 25: No. 4, 321-328(Apr 1974).

The radioprotective activity of cysteine was progressively destroyed by ionizing radiation greater than 28.8 krads. Acholeplasma laidlawii B cells were protected after brief pre-irradiation exposure to cysteine, and this response it is suggested may be membrane-mediated. As the equilibrium concentration of cysteine in the pleuropneumonia-like organism was increased, the rate of cell inactivation decreased monotonically in N_2 and biphasically in air over the concentration ranges examined; in N_2 the decrease was proportional to the logarithm of the cysteine concentration incorporated metabolically into the cell membrane. (auth)

15829 COMPARATIVE TESTS WITH FORMOLIZED AND IRRADIATED VACCINES AGAINST LEPTOSPIROSIS. Babudieri, B.; Castelli, M.; Pisoni, F. (Univ., Trieste, Italy). Bull. World Health Organ.; 48: 587-590(May 1973).

The effectiveness of gamma-irradiated antileptospirosis vaccines and of vaccines killed with formol was compared in guinea-pigs. Irradiated vaccines proved no more effective than formolized vaccines in preventing either death or persistent kidney infection. Anti-pomona vaccines gave little protection against serotype icterohaemorrhagiae, and there was no significant difference between irradiated and formolized preparations. Vaccine prepared from a virulent strain showed little advantage over vaccine prepared from weak strains. (auth)

15830 NATURAL AND UV-INDUCED VARIATION OF NYSTATIN-PRODUCING ORGANISM ACT. Noursei, Strain 0187. Lavrent'eva, G. I.; Zhukova, R. A.; Demchenko, L. N.; Kotenko, T. V. (Leningrad Research Inst. of Antibiotics). Antibiotiki; 18: 692-696(Aug 1973). (In Russian).

Natural and uv-induced variation of the nystatin-producing organism Act. noursei, strain 0187 differing from strain 157 by higher content of component A_2 was studied. The ratio of components A_1 and A_2 in the samples of nystatin obtained from strain 0187 was 1:1. A variant with an activity higher than that of the population by 26 per cent was isolated from platings of strain 0187. Dependence of the survival of the spores of strain 0187 on the dose of ultraviolet light was exponential. The culture variation with respect to the property of the antibiotic production increased primarily at the expense of higher rate of the low active variants. The optimal doses for the plus variants were 1000 and 2000 erg/mm^2 at the spore survival within 0.1 to 5.0 per cent. UV-mutants with activity 2 times higher than that of the initial strain were obtained. The ratio of components A_1 and A_2 in the samples of nystatin from the uv-mutants was at the level of the control. (auth)

15831 EFFECTS OF GAMMA IRRADIATION ON MYCOBACTERIOPHAGES, ON THEIR INFECTIOUS DNA'S, AND ON MYCOBACTERIUM SMEGMATIS. Xavier, A. M. Los Angeles; University of California (1973). 86p. University Microfilms Order No. 74-3991.

Thesis (Ph.D.).

The effects of cobalt-60 gamma irradiation on mycobacteriophages D29, D32, and D4, on their biologically-active DNA's, and on their host Mycobacterium smegmatis have been investigated. Factors influencing survival included radiation dose, dose rate, medium in which the infectious agents were irradiated, and time elapsed between irradiation and assay. The criterion used for bacterial and phage survival was the ability to form colonies and plaques, respectively, and in the case of isolated phage DNA the ability to transfect competent bacterial cells. Rates of phage inactivation varied greatly with composition of the suspending medium. $D_{\frac{1}{2}}$ values for phages irradiated in nutrient broth at an initial titer of 10^8 PFU/ml were 21.6 krad for D29, 21.7 for D32, and 33.5 for D4; in phosphate buffer these values dropped to between 0.5 and 1.5 krad. The corresponding value for D4 irradiated in organic Tris buffer was 18.4 krad. Apparently, some components of nutrient broth and of Tris buffer acted as protective substances or as radical scavengers, competing with the phage particles for the deleterious agents produced in the media by the radiation. Inactivation of phage irradiated in nutrient broth appeared to follow one-hit kinetics. Dose-survival curves were exponential until bending downward at survival levels between 10^{-1} and 10^{-2}, thus suggesting operation of a second inactivating mechanism, due possibly to accumulation of toxic substances in the medium. Phage inactivation in broth showed no dependence on dose rate. Inactivation rates in phosphate buffer increased with decreasing concentration of phage particles. Whether this was due to a concentration dependence and/or to elimination of protective organic substances by dilution was not determined. The influence of various host species on survival of irradiated phages was not significant. Survival curves for D32 were identical whether measured on M. smegmatis ATCC 607 or on M. sp. ATCC 9033; curves for D4 were the same on ATCC 607, M. avium ATCC 4576, and M. ranae. Survival of irradiated D29 or D4 phages on the wild-type strain of ATCC 607 was not significantly different from that on UVS-6, a mutant strain sensitive to ultraviolet light. (Diss. Abstr. Int., B)

15832 EFFECT OF ^{32}P DECAY ON INFECTIVITY OF TOBACCO MOSAIC VIRUS. Takagi, Y.; Ikegami, M. (Osaka Prefectural Univ., Sakai, Japan). Nippon Shokubutsu Byori Gakkaiho; 38: No. 5, 410-413(Dec 1972).

Survival of ^{32}P-labeled tobacco mosaic virus (TMV) decreased exponentially with time and it became about $\frac{1}{8}$ of original amount after 28 days storage. However, no reduction in survival of the virus was noted when unlabeled TMV was mixed with ^{32}P-orthophosphate. Despite loss in infectivity, no destruction of virus particles could be seen in electron microscopic observation of ^{32}P-labeled TMV after 28 days storage. The results suggest that the loss of infectivity of ^{32}P-labeled TMV is due to transmutation ($^{32}P \rightarrow {}^{32}S$) of the isotope incorporated in the virus particles, and not due to ^{32}P β-radiation. (auth)

15833 ROLE OF CAROTENOID PIGMENTS IN RADIO-RESISTANT MICROCOCCI. Lewis, N. F.; Alur, M. D.; Kumta, U. S. (Bhabha Atomic Research Centre, Trombay, India). Can. J. Microbiol.; 20: No. 4, 455-459(Apr 1974).

The carotenoid pigments of two radioresistant bacteria, Micrococcus radiodurans and Micrococcus radiophilus, were affected qualitatively by culturing them in the presence of nicotine, and quantitatively by culturing them in the presence of diphenylamine or at extreme pH levels. Alteration of the pigment content of these organisms, either qualitatively or quantitatively, had no effect on their sensitivity to γ irradiation. Cells of these radioresistant micrococci, which normally contained predominantly ketocarotenoids, were found to accumulate the acyclic carotenoid lycopene when grown in the presence of nicotine. Pigments of nicotine-grown cells were stable to 3.0 Mrad as compared with those of either DPA-grown or normal cells which were totally destroyed at 1.0 Mrad. (auth)

15834 RADIATION RESPONSE OF ENERGY-DEFICIENT YEAST MUTANTS: THE RELATIONSHIP OF RADIORESISTANCE TO RESPIRATORY AND CATALASE ACTIVITIES AS MEASURED BY OXYGEN POLAROGRAPHY. Bruce, A. K.; Parker, J. H. (State Univ. of New York, Buffalo). Can. J. Microbiol.; 20: No. 4, 587-593(Apr 1974).

The radiation response of a group of respiration-deficient mutants of yeast was determined. Respiration and catalase activity was measured by a polarographic technique. Radiation response, as measured by D_0, is correlated with both respiratory and catalase activities. Cultures grown in chloramphenicol were also examined. In these cultures, radiation response (D_0) and respiration were both markedly decreased while catalase activity was generally increased. From these data it was concluded that respiratory capacity may be involved in determining the radiation sensitivity of yeast cultures whereas catalase activity does not participate. Further, although the enzymes of the respiratory system and those generally associated with the peroxisome are similar chemically and functionally, they are controlled by different regulation systems. (auth)

Radiation Effects on Plants

Refer also to abstracts 14976, 15378, 15780, 15795, 16065, and 18113.

15835 (AEC-tr-7540) PRESOWING IRRADIATION OF SEEDS OF AGRICULTURAL PLANTS. Berezina, N. M. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Translated by Martha W. Gerrard and Philip S. Baker from Predposevnce Obluchenie Semyan Sel'Sko-Khozyaistvennykh Rastenii, Atomizdat, Moscow 1964. 190p. Dep. NTIS $7.60.

The principal reports on the effects of stimulating doses of radiation on seeds are summarized. The theoretical basis of the technique is explained and methods of presowing irradiation are presented. Among the crops studied were cotton, corn, carrots, radishes, cabbages, and tomatoes. Numerous tables are presented to show effects of radiation on yield, biochemical changes, and other factors. (HLW)

15836 (COO-2085-9) IN VIVO AND IN VITRO EFFECTS OF ACUTE GAMMA IRRADIATION ON USNIC ACID IN THE LICHEN CLADONIA SYLVATICA (L.) HOFFM. Funkey, G. E. (Michigan Technological Univ., Houghton (USA)). 1974. 65p. Dep. NTIS $6.25.

Thesis.

The effects of acute gamma radiation on usnic acid in vitro and in vivo were studied with respect to any protective properties this substance may have against radiation damage in the lichen, Cladonia sylvatica. It was determined that acute irradiation to 10^6 rad had no noticeable effect on usnic acid in vitro but caused a decrease in concentration of usnic acid present with respect to controls, if the lichen were placed back in the field and remained there through a growth season after being irradiated. Lichen samples irradiated and placed back into the field through 4 winter months appeared significantly different from the nonirradiated controls in terms of color and texture. However, these lichens did not show a decrease in usnic acid content. (CH)

15837 GENETIC VARIATION OF THE CYTOPLASMIC MALE STERILITY INDUCED BY GAMMA IRRADIATION IN SUGAR BEETS. Kinoshita, T.; Takahashi, M. (Hokkaido Univ., Sapporo). Tensai Kenkyu Hokoku, Suppl.; 13: 73-77(Feb 1972). (In Japanese).

In a previous paper (Kinoshita and Takahashi 1969), the authors reported that the cytoplasmic male sterility was induced by the gamma irradiation of the seeds in the strains, H-19 and H-2002 with normal cytoplasm. Further experiments were carried out to investigate the genetic variation of the induced male sterility. The male sterility that appeared in M_1 plants was transmitted to M_2 lines in a relatively high frequency. The mode of segregation in male sterile types differed remarkably among the M_3 lines which were produced from the completely sterile plants in M_2 under open pollination in an isolated field. The frequency of male sterile plants (S.S.b. and C.S.) varied from 59% to 97% in the M_2 lines. Crossing experiments were made between C.S. type plants from γ-20, γ-27 and γ-54 lines, and five pollinators which were chosen from a population of H-2002 with N cytoplasm. A complete sterile plant from H-19 MS with S cytoplasm was crossed with the same pollinators. Modes of inheritance were not homogeneous among the offsprings from different female plants crossed with the pollinators, H-2002-1, H-2002-3, and H-2002-5. The percentage of male-fertile plants (N and S.S.a.) appeared in offsprings of the crosses, C.S. type x pollinators, also differed from 7% to 34%, among different female plants crossed with the specific pollinators. Thus, it is probable that the new genetic interrelation was induced between the nucleargenes and the plasmagenes as a consequence of the cytoplasmic mutation by the gamma irradiation. (auth)

15838 CYTOGENETICS OF THIRTEEN RADIATION-INDUCED RECIPROCAL TRANSLOCATIONS IN COLLINSIA HETEROPHYLLA. Zaman, M. A.; Rai, K. S. (Univ. of Notre Dame, IN). Cytologia (Tokyo); 37: No. 4, 629-638(Dec 1972).

Cytogenetic data on thirteen radiation-induced translocations in the same species in two (X_2 and X_3) generations are presented. All translocations studied had two nonhomologous chromosome pairs involved. Most of the translocation heterozygotes showed directed orientation of the interchange complexes at metaphase I in both the X_2 and X_3 generations. RT-M showed random orientation, and RT-N and RT-P displayed reversal from directed to random orientation or vice versa in these generations. These data combined with metaphase I chromosomal configurations observed for the various translocation indicated that RT-M resulted from breaks in the terminal or sub-terminal chiasma-forming regions of the two chromosome pairs involved (behavior similar to that of colchicine-induced translocations of Soriano). The rest of the translocations had breaks in the internal non-chiasma forming regions. While the breaks in RT-Q and RT-R_2 may have been just proximal to the chiasma-forming regions, the breaks in the remaining translocations appear to be nearer the centromere than the chiasma forming segments. Thus two types of translocation behavior reported earlier for two different mutagens were observed in the present study involving the gamma irradiation of 1000 to 1600 R using 10 KCi ^{60}Co at a dose rate of approximately 300 R per minute, and the results in general support the underlying mechanical hypothesis for the random versus the directed types of orientation proposed earlier by Garber and Dhillon for C. heterophylla. However, genetic factors may also influence the orientation of the interchange complexes at metaphase I. (auth)

15839 TOXIC AND GENETIC FACTORS LIMITING THE INCREASE OF MUTATION FREQUENCY AFTER TREATMENT WITH ALKYLATING NITROSO COMPOUNDS AND X RAYS ON ARABIDOPSIS. Gichner, T.; Veleminsky, J. (Experimentalni Botaniky, Prague). Biol. Plant. (Prague); 15: No. 5, 350-353 (1973).

The high M_1 sterility is a factor limiting an increased mutation frequency after treatment with nitrosoamides, such as N-methyl-N'-nitro-N-nitrosoguanidine, N-methyl-N-nitrosourea, N-methyl-N-nitrosourethane, and N-ethyl-N-nitrosourethane, whereas for ethylvinylnitrosoamine treatment the limiting factor is the toxic action on the M_1 seed germination. A decreased mutation frequency at high dimethylnitrosoamine doses is explained by the inhibition of enzymes or enzyme-like systems which hydroxylate nitrosoamines in vivo and thus enable the production of a mutagenic alkylating intermediate. An increased mutation frequency after treatment with x-rays is limited both by the decreased M_1 survival and the M_1 fertility. (auth)

15840 ROLE OF PEROXIDASE IN MEDIATING RADIATION-INDUCED DAMAGE IN SAINTPAULIA IONANTHA WENDL. Warfield, D. L. Pullman, WA; Washington State Univ. (1973). 61p. University Microfilms Order No. 74-4134.

Thesis (Ph. D.).

Peroxidase, an enzyme known to degrade radical peroxides in vitro, was investigated to determine its role in mediating radiation-induced biological damage in cells. Saintpaulia ionantha Wendl., cultivar O'linda sport was the experimental organism. Five leaf-peroxidase levels were used in the experiment. The lowest level, .2X, was found in ¾-grown leaves. The base level, 1X, was the amount of peroxidase in fully expanded, mature leaves. Three higher levels (3X, 6X, 10X) were obtained by treating 1X leaves with ethylene gas for 2, 3, and 4 days, respec-

tively. Treatment of leaves with ethylene for longer times induced higher amounts of peroxidase; however, the leaves showed reduced viability. Peroxidase levels, both natural and induced, were stable in non-irradiated leaves. In leaves treated with X rays there was an increase in the amount of peroxidase; this increase was dependent on both the initial level of peroxidase and on the dose of radiation. As the initial level of peroxidase increased, the response of peroxidase to 5.5 KR of X rays decreased. Peroxidase in leaves increased with increasing dose up to a point. A dose of 3.3 KR of X rays induced only ¾ the increase caused by 5.5 KR; however, 7.7 KR induced only a marginal increase above 5.5 KR. Levels of catalase and cytochrome c oxidase were unchanged by treatment with ethylene. In addition, no change in peroxidase isozymes was noted with treatment by ethylene or radiation. Three biological parameters were measured to assess the effect of peroxidase level on mediating radiation-induced damage: leaf survival, plantlet production, and percent mutant progeny. Leaves at .2X,3X,6X, and 10X peroxidase levels showed no significant differences in the three parameters from control, 1X, leaves when no radiation was applied. A lethal dose of radiation (10 KR) caused leaves at 3X, 6X, and 10X peroxidase levels to die with increasing rapidity. Since leaves at .2X and 1X levels displayed no difference in time to death, the killing effect is not thought to be due to the peroxidase level per se. Leaves of all five peroxidase levels showed no difference in response to a dose of 5.5 KR in the parameters of leaf survival and plantlet production. With regard to percent mutations, there was a significant decrease at the 10X peroxidase level. (Diss. Abstr. Int., B)

15841 EFFECTS OF GAMMA-IRRADIATION ON SELF-INCOMPATIBILITY OF CABBAGE (BRASSICA OLERACEA L.). Hosoda, T.; Namai, H.; Tsuyama, T. (Tokyo Univ.). Gamma Field Symp.; No. 10, 1-10(Mar 1973).

Effects of gamma irradiation on self-incompatibility at the various reproductive stages of self-incompatible cabbage were investigated. Self-incompatible but cross-compatible clones from the cabbage were used. All the irradiations were conducted using gamma rays from ^{60}Co in a gamma-field. Four to six plants grown in pots were irradiated at each reproductive stage. The plants were exposed to 350 R/day. When some basal flowers of an inflorescence had opened, all opened and naturally pollinated flowers were discarded, and one day thereafter, some secondary inflorescences which had three to five newly opened flowers were used for opened self-pollination, and in addition, five to fifteen buds in each inflorescence were used for bud self-pollination. Those inflorescences were covered with paraffin paper bags, and viable seeds per pollinated flower were counted after their maturity. Self-fertility of the bud pollination was lower in the irradiated plants than in the control, however, it was clear than when plants were irradiated after pollination, especially within six days from two weeks after the pollination, the self-fertility became even higher. (JA)

15842 BIOLOGICAL DOSIMETER FOR FAST NEUTRONS. Lin, Y. M.; Cheng, C. H. (Atomic Energy Council, Taipei, Taiwan). Nucl. Sci. J. (Taiwan); 8: No. 2, 11-16(Jun 1971).

The methods for neutron dose measurement in a standard neutron irradiation facility for research reactor using barley seeds as the biological dosimeter are discussed, and the results are compared with those obtained by other reactor laboratories in order to obtain an accurate and reproducible set of data. The standard procedures for irradiating, cultivating, and measuring barley seeds to determine the effects of neutron irradiation are described, and the analysis of seedling-growth data is also included. (auth)

15843 EFFECT OF GAMMA RAYS AND SOME CHEMICAL MUTAGENS ON INDUCTION OF TELOTRISOMICS IN HORDEUM. Sayed, H. I.; Helgason, S. B.; Larter, E. N. (Univ. of Manitoba, Winnipeg). Can. J. Genet. Cytol.; 15: No. 4, 815-824(Dec 1973).

Trisomic lines for each of chromosomes 1, 3, 4, 5, and 7 of barley (Hordeum vulgare L.) were subjected to mutagens viz, EMS, DES, HA, FUdR, and γ rays in an attempt to induce telocentrics in the extra chromosome. DES and EMS caused a relatively high degree of lethality of trisomics compared with that of disomics. Treatment with HA and γ rays at the time of meiosis caused almost complete sterility. No telotrisomics were recovered from these treatments. Irradiation of trisomic seedlings resulted in the isolation of 11 fragments of which 6 were true telocentrics. The frequency of telocentrics was significantly increased over non-treated material only in stocks of trisomic for chromosomes 1 and 7. All chromosome breaks induced in chromosome 7 were localized at the centromere and the adjacent region of the long arm. (auth)

15844 GAMMA RADIATION SENSITIVITY OF SCOTS PINE SEEDS. Velkov, D. Gorskostop. Nauka; 9: No. 4, 11-22(1972). (In Bulgarian).

The effect of γ radiation (^{60}Co) exposures of 500, 2500, 5000 and 10,000 Rö, with a capacity of the device of 1632 Rö/min, on the germination of Scots pine seeds, was studied with samples taken from Mount Rila, at 1200, 1400 and 1700 m above sea level. Seeds, dry and soaked in water, were subjected to exposure for 6 and 24 hours. As a result of soaking, the moisture content of the seeds rose from 5 to 8 times for the different altitudes. The investigations show that the sensitivity to radiation of Scots pine seeds depends on their origin: with the rise in the altitude above sea level, the LD_{50} decreases correspondingly. The increase in moisture content and the longer time of soaking the seeds in water result in a decrease in their radiosensitivity. It was found that Scots pine seeds from the area of Mount Rila are more gamma-radiation-resistant in comparison with data known so far on this resistance. Gamma exposure higher than 500 Rö does not stimulate the germination of Scots pine seeds. (auth)

15845 INCREASED VEGETATIVE AND GENERATIVE PLANT GROWTH INDUCED BY PRE-SOWING TREATMENT OF SEEDS WITH SMALL γ RADIATION DOSES. Kahan, R. S. (Soreq Nuclear Research Centre, Yavne, Israel). pp 412-424 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Results are presented from studies on plants grown from seeds exposed to low doses of γ radiation that demonstrate that application of such doses to seeds of flowering-plants before sowing can induce faster growth of green top and roots and increased yields of fresh and dry organic matter in plants which are not distinguishable morphologically from the non-irradiated controls. This is therefore not a mutant effect, nor is it the result of cancerous growth. In some species earlier development of the generative organs occurs, such as of inflorescences, flower opening, and fruit set. This may lead to increased crop yields at the beginning of the harvest season or to bigger overall harvests. Doses of 50 and 100 rads increased the germination incidence of bell-pepper seeds from 70% to 75% and 88% respectively, possibly by destruction of a germination inhibitor. With some grass and tomato varieties no increase in germination was caused but the seedlings grew more rapidly and gave more fruits. Possible mechanisms are discussed. (auth)

Radiation Effects on Animals

Refer also to abstract 15775.

15846 (CONF-740331-3) T-CELL RADIATION SENSITIVITY DURING IMMUNE INTERACTION. Gottlieb, C. F.; Makinodan, T. (Oak Ridge National Lab., Tenn. (USA); Baltimore City Hospitals, Md. (USA)). 1974. 19p. Dep. NTIS $4.00.

From interaction of radiation and host immune mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

It is well known that the humoral immune response to sheep erythrocytes (SRBC) depends on the presence of two populations of immunocompetent cells, B cells, which are the precursors of the antibody-forming cells, and T cells, which serve as helpers to the B cells. Interaction of these two cell types is necessary to produce antibody against SRBC. The T cell is limiting in this response so the radiosensitivity of the overall anti-SRBC response is an indirect measure of the radiosensitivity of T cells. Results are reviewed from studies on the radiosensitivity of T cells in vivo and in cultured cells. It was concluded that, although extensively studied, the effect of radiation on immune responses is only partially understood. Frequently the radiation effect is interpreted solely as cell death resulting from radiation damage, as implied by the survival curves. Albeit cell death is a mjaor contribution, numerous other phenomena are likely to be involved, including homeostatic regulation and corticosteroid control. Very little is known about the nature of repair of sublethal radiation damage or the recovery of the population of cells involved in the immune system. The control of differentiation and proliferation as they are involved in adaptive immunity is complex in the mammal, and our understanding is still quite limited. (CH)

15847 (INIS-mf-987, pp 4.1-4.48) RADIATION DAMAGE: MECHANISM AND FACTORS WHICH INFLUENCE IT. Lander, H. (Univ. of Adelaide). 1972.

The various types of ionizing radiations and their interactions with matter are described. The radiation effects on chemical systems such as aqueous systems or organic molecules are described as well as the biological radiation effects on animal cells. A discussion is given on genetic radiation effects following whole-

body irradiation, dose-response relationship, radiation injuries, and delayed radiation effects. Some of the more important late somatic effects include: increases susceptibility to infection consequent upon immunological depression, teratogenesis in the embryo, cataract formation, sterility, reduction of life span, and cancer induction. Factors which influence the effects of irradiation are quantity or quality of radiation, time duration, recovery mechanisms, and chemical effects. (INIS)

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Refer also to abstracts 15375, 15461, 15762, 15770, 15783, 15789, 15826, 15982, 15986, 16014, 16015, 16094, 16537, 18029, 18030, 18033–18035, and 18037.

15848 (AD-765334) OBSERVER DISTANCES FOR NUCLEAR EVENTS. Volume I. Model for Observer Distances for Retinal Burn Criteria. White, T. J. (General Electric Co., Santa Barbara, Calif. (USA). DASA Information and Analysis Center). Mar 1973. Contract DASA01-70-C-0035. 256p. (DASIAC-SR-125). NTIS $6.25.

A comprehensive model is described for estimating observer distances from nuclear detonations for protection against retinal burns from criteria based on temperature rise. Detailed descriptions are given of all factors which influence observer distances. Scaling relationships for the nuclear weapon thermal pulse are derived for a wide range of altitudes and yields. Exemplary results are shown for safe observation distances. A sensitivity analysis based on calculated observer distances gives an estimate of prediction quality. (auth)

15849 (DHEW-74-8021) CANCER OF THE CERVIX. Proceedings of a Conference of the Working Party on Radionuclides and Afterloading Techniques in the Treatment of Cancer of the Uterus in Developing Areas, Second Meeting, Rio de Janeiro, Brazil, May 30–June 1, 1973. Simon, N. (Ed.). (Bureau of Radiological Health, Rockville, Md. (USA)). Mar 1974. 444p. (CONF-730594-). GPO $4.15.

The incidence of cancer of the cervix of the uterus in women residing in developing countries (India, Taiwan, Nigeria, Venezuela, Mexico, Guatemala, Tunis, Puerto Rico, Chile, and Brazil) is discussed and various therapeutic methods are considered. The importance of early treatment using intracavitary radiation sources is emphasized and the advantages and disadvantages of ^{226}Ra, ^{137}Cs, ^{60}Co, and ^{192}Ir for use as γ implant sources are considered. It was concluded that ^{137}Cs offers the most advantages based on the fact that it emits 0.66 MeV monoenergetic γ radiation, has a half-life of 30 y, is a fission product and therefore should be abundant and inexpensive, problems of radiation protection during handling and storage are simpler than with the other three sources considered, it is available in physical and chemical inert forms, it does not emit gaseous daughter products to cause possible rupture of the capsule, it is manufactured in the form of a white powder incorporated in ceramic material that reduced hazards from inhalation or ingestion and is easily removed from surfaces in the event of a spill or accident, and it is available is calibrated sources ready-mounted in holders for insertion into afterloading applicators. It is estimated that an investment of $3,000 will provide enough ^{137}Cs afterloading sources to treat 100 cancer patients per year, assuming two applications per patient. Data are tabulated on the five-year survival rate of patients treated with ^{137}Cs source implants, and a comparison is made with treatment using other implant sources and external irradiation. Complications following ^{137}Cs implant therapy were observed in less than 10% of the patients, and only two percent required surgery to repair radiation injuries of the rectum or other tissues. Equipment and procedures for operating a radiotherapy clinic are described. (CH)

15850 (GWI-R-3/74) CEREBRAL RADIATION SURGERY WITH NARROW GAMMA BEAMS. Physical Experiments. Sarby, B. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Mar 1974. 32p. Dep. NTIS (US Sales Only) $4.75.

The physical and geometrical demands on the single beam channel for the precise irradiation of small intracranial neoplasms with ^{60}Co γ radiation were evaluated. Model experiments, performed with the aid of photographic dosimetry on various types of collimating systems, in combination with theoretical calculations on an idealized beam geometry showed the possibility of shaping well-collimated γ beams with a sufficiently high energy fluence rate. Unwanted contributions to the dose in regions outside the geometrical edges of the primary beams due to scattering and transmission effects were studied. (SW)

15851 (GWI-R-4/74) DESTRUCTION OF SMALL INTRACRANIAL TUMOURS WITH ^{60}Co GAMMA RADIATION. Physical and Technical Considerations. Dahlin, H.; Sarby, B. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Mar 1974. 34p. Dep. NTIS (US Sales Only) $4.75.

The clinico-physical conditions for the obliteration of small intracranial tumours by means of multiple gamma beam irradiation were evaluated. The effects of the collimation of the single beam and the spatial distribution of 179 beams on the superimposed three-dimensional dose distribution were studied experimentally and theoretically. Techniques for selective irradiation of tumours of various types and sizes are discussed. (SW)

15852 (GWI-R-5/74) EQUIPMENT FOR RADIATION SURGERY USING NARROW 185-MeV PROTON BEAMS. Larsson, B.; Sarby, B. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Apr 1974. 60p. Dep. NTIS (US Sales Only) $6.00.

The purpose of the work described in this paper was to optimize and standardize irradiation conditions and dosimetry in order to investigate the prerequisites for the routine use of narrow high energy proton beams for therapy of cerebral neoplasms. The beam was collimated and led to the place where the irradiations were to be performed, 25 meters from the synchrocyclotron, with a system of focussing quadrupole magnets and bending magnets. Final collimation of the beam penetrating the skull was arranged with a system of accurately aligned cylindrical and plane-parallel metal apertures. The energy of the protons in the beam was 185 ± 0.2 MeV and the maximum total fluence was 5×10^{10} protons/s. A method of ^{11}C activation dosimetry was developed with which an absolute determination of the fluence and the dose in the proton beam could be made with good accuracy. Monitoring of the dose during irradiation was performed with an ionization chamber. The properties of the narrow proton beam as it passed through brain tissue, were studied by means of measurements on the density distributions of photographic films exposed in phantom material. (SW)

15853 (GWI-R-6/74) TECHNIQUES FOR IRRADIATION OF SMALL STRUCTURES THROUGH THE INTACT SKULL. Larsson, B.; Liden, K.; Sarby, B. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Apr 1974. 37p. Dep. NTIS (US Sales Only) $5.00.

For selective destruction of brain neoplastic tissue volumes of diameters of about 2 to 12 mm at a depth of 6 to 10 cm by irradiation methods were evaluated using high-energy electrons, supervoltage x radiation, γ radiation from a ^{60}Co source, and fast neutrons. The great advantage in the use of a γ beam is the absolute reproducibility. The only physical factor that varies slightly is the dose rate. Design of a ^{60}Co source for γ radiation is described, with special attention to the beam collimation, beam geometry, and radiation protection. (SW)

15854 (GWI-R-7/74) INFLUENCE OF ABSORBED DOSE AND FIELD SIZE ON THE GEOMETRY OF THE RADIATION–SURGICAL BRAIN LESION. Dahlin, H.; Larsson, B.; Rosander, K.; Sarby, B.; Leksell, L.; Steiner, L. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Apr 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

Specimens from a number of patients obtained following local irradiation of the thalamus for intractable pain using a multiple gamma beam technique were studied histologically. The geometry of well circumscribed necrotic lesions was ascertained. No correlation was seen between the dimensions of the lesions and the size of the field, within the clinically useful dose range (16 to 25 krad). (auth)

15855 (INIS-mf-905) ANNUAL REPORT, 1972. (Statens Institutt for Straalehygiene, Oslo (Norway)). 10 Aug 1973. vp. (In Norwegian). Statens Institutt for Straalehygiene, Montebello, Oslo 3, Norway.

The Institute is divided into a radiophysics and a radiomedical section. The radiophysics section is again divided into two departments, the first dealing with medical use of radiation sources, the second with radiation used in industry, research, and higher education, and atomic energy. A list of the surveillance work carried out all over Norway is given. X-ray diagnostic equipment has been inspected in 164 clinics. Special emphasis has been placed also in 1972 on x-ray apparatus used specifically in surgery. With the surveillance of 152 dental x-ray apparatuses, the inspection of the total stock of some 2900 dental installations in Norway has been completed. Ten medical clinics using open radionuclides have been inspected. In the industrial field 21 installations using radioisotopes for process control and 19 radiation sources used for quality control were routinely inspected. In the surveillance of individual radiation doses, the data observed by the State Institute of Radiation Hygiene, and data measured by other institutions with their own health physics departments are given. Doses received by patients and members of the staff of radiology have been measured and operational procedures have been studied. Special measurements with an anatomical phantom have also been carried out. The work in the field has mainly been completed in 1972, and the results will be published. (INIS)

15856 (JPRS-61905, pp 48) HEMORRHAGIC SYNDROME OF ACUTE RADIATION SICKNESS. Krantz, S. 1973. Translated from Zeitschrift fuer Militaermedizin; 14: 323-325(Nov 1973).

The hemorrhagic syndrome of acute radiation sickness in man represents a complex physiological and biochemical event which, apart from thrombocytopenia and changes in membrane permeability, has been investigated insufficiently in relation to changes in the conformation and biological properties of proteins which are involved in the process of blood clotting. For example, it is possible to discuss potential mechanisms of pathogenesis of the hemorrhagic syndrome following irradiation, and the complexity of the possible changes which involve fibrinogen-fibrin transformation, on the basis of what is known about fibrinogen and the factors which are known to alter fibrinogen-fibrin transformation. (auth)

15857 (ORNL-tr-2836) EXTREME SENSITIVITY OF HUMAN CELLS TO IONIZING RADIATION FOR A FORM OF HEREDITARY DISEASE: XERODERMA PIGMENTOSUM. A Study of Single Strand Breaks of DNA and Chromosome Aberrations. Mikhelson, V. M.; Haikasyan, E. V.; Genter, E. I.; Pleskach, N. M. Translated by M. Gerrard from Tsitologiya; 16: No. 2, 203-210(1974). 9p. Dep. NTIS $4.00.

A form of Xeroderma pigmentosum with extreme sensitivity to ionizing radiation has been discovered. Lymphocytes of peripheral blood of the patient show a higher frequency of radiation-induced chromosome aberrations than normal lymphocytes and the absence of rejoining of γ-induced single strand breaks of DNA. Caffeine, which inhibits DNA repair in normal lymphocytes, produces no effect on cells from patients with such a form of Xeroderma pigmentosum. Replicative synthesis of DNA in the cells of these patients was slowed down without irradiation. The discovered form of Xeroderma pigmentosum differs from the form with unchanged DNA sensitivity to ionizing radiation investigated recently (Cleaver, 1969; Kleijer et al., 1970). (auth)

15858 (ORNL-tr-2838) CRITICALITY. (CEA Centre de Production de Plutonium de Marcoule, 30-Bagnols-sur-Ceze (France). Service de Protection contre les Radiations et d'Assainissement Radioactif; CEA Centre de Production de Plutonium de Marcoule, 30-Bagnols-sur-Ceze (France). Services d'Extraction du Plutonium). 30 Jun 1967. Translation by M. Gerrard of a French Brochure. 22p. Dep. NTIS $4.25.

The chain reactions leading to criticality, safety measures for the prevention of criticality accidents, biological consequences of radiation exposure during criticality accidents, radiation dosimetry, and radiation protection measures for personnel working in areas where criticality may occur are briefly described and illustrated graphically by numerous styalized technical cartoons. (CH)

15859 (SGAE-2255) IN VIVO DNA REPAIR STUDIES IN THE COURSE OF THERAPY WITH ANTIRHEUMATICS. Tausch, G.; Tuschl, P.; Dunky, A.; Eberl, R. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Inst. fuer Biologie). Feb 1974. 12p. (In German). Dep. NTIS (US Sales Only) $4.00.

In vivo studies with human lymphocytes were made to determine possible changes in DNA synthesis and repair during therapy with antirheumatic drugs. The drugs studied were indometacin, azopropazone, flufenaminic acid, and prednisolone. The inhibiting effect of ^{60}Co γ radiation on the synthesis and recovery of DNA in irradiated lymphocytes was also determined. (JSR)

15860 RADIATION AND POLLUTION ASSOCIATIONS WITH DISEASE-SPECIFIC MORTALITY. Rogers, V. C. (Intelcom Rad Tech, San Diego, CA); Sanquist, G. M. Trans. Amer. Nucl. Soc.; 18: 44-45(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15861 PERSONNEL EXPOSURE EXPERIENCE AT H. B. ROBINSON UNIT 2. Webster, B. H. (Carolina Power and Light Co., Raleigh, NC); Harness, J. L. Trans. Amer. Nucl. Soc.; 18: 356-357(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15862 NO-EFFECT LEVEL AND EXTRAPOLATION AS APPLIED TO PESTICIDE RESIDUES AND RADIOACTIVE SUBSTANCES. Coulston, F.; Wills, J. H. (Albany Medical Coll. of Union University, NY). pp 561-571 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The philosophy of extrapolating animal data on the toxic, mutagenic, teratogenic, or carcinogenic effects of chemicals or radioactivity to man is discussed, as is the applicability of the "no-effect level" principle. The difficulties inherent in extrapolating data from high doses of test compound or radiation to data at low doses within the same species, let alone predicting results in man, are commented on, and the advantage for certain studies in using log-dose/probit transformations are illustrated by examples. Risk/benefit assessments are part of our everyday life, and must also be applied intelligently to problems involving use of toxic substances or radiation, making use of the best-available data and revising the assessments in the light of growing knowledge and availability of less toxic compounds or improved technology. (auth)

15863 RADIATION PHYSICS AND EVALUATION OF CURRENT HAZARDS. Curtis, S. B. (Univ. of California, Berkeley). pp 21-99 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Results are summarized from studies of radiation exposures occurring in various regions of space. Dosimetric data obtained by satellites and on space craft during manned flights are reviewed. It is pointed out that the major problem in space flight is from solar particles and a more accurate prediction method for solar flares and subsequent fluxes and energy spectra would be invaluable in warning astronauts who might be in exposed regions outside adequate shelter. For short-term space flight a dose rate of about 10 to 20 mrads/day at an altitude of 200 to 300 km is not considered hazardous for astronauts. Longer missions at higher altitudes will require adequate shielding to reduce the radiation hazards. It is postulated that both personnel dosimeters and particle spectrometers will be necessary on spacecraft on extended manned missions in order to evaluate the total radiation exposure of the crew. (130 references) (CH)

15864 MAMMALIAN RADIOBIOLOGY AND SPACE FLIGHT. Aceto, H. (Coll. of William and Mary, Williamsburg, VA); Leith, J.; Baker, D. pp 353-433 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.) New York; Academic Press, Inc. (1974).

Data are reviewed from studies on the effects of radiations on laboratory mammals, with emphasis on those effects pertinent to space flight situations. It is pointed out that during space flights of several weeks to a few months duration the greatest hazard is from solar flare radiation and that the radiation injuries would be caused predominantly by high-energy protons. The astronaut will be subjected to biological stress caused by vibration, acceleration, weightlessness, changes in gas composition and barometric pressure, and emotional psychic effects that may affect his ability to mobilize effective defenses against any single stressor, such as the response to high doses of non-random high-energy heavy nuclei components of cosmic radiation and high-energy protons produced by solar flares. The early and delayed effects of space radiations on the skin, central nervous system, gastrointestinal tract, and hematopoietic system of astronauts as a function of depth dose distributions, LET, dose rate, fractionated exposure, tissue recuperation, and environmental factors, are postulated on the basis of data available from laboratory studies. However, it is emphasized that the responses of these organ systems interact with one another and activate a variety of systemic factors which determine the course and eventual outcome of any injury to the organism. (350 references) (CH)

15865 HUMAN RADIATION TOLERANCE. Lushbaugh, C. C. (Oak Ridge Associated Universities, TN). pp 475-522 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Data on human radiation dose responses are summarized. Knowledge of human reponses to radiation is based on case histories of victims of radiation accidents and patients who have received either local or whole-body irradiation as therapy for their diseases. The correlations of human responses during therapy are based on accurate radiation dose measurements but the response is confused by disease symptons that often resemble radiation-induced responses, and there are no reports of radiation accidents where the actual dose in known and estimates of the radiation dose based on mock-up of the exposure situation are not always accurate. The data on radiation exposure of the populations of Hiroshima and Nagasaki are of no help in establishing the course of events leading to the radiation syndrome in man since medical teams arrived too late to observe early responses and the clinical picture of the survivors was complicated by exposure to large amounts of thermal radiation and blast trauma. None of the available data has shown the radiation response of man to differ qualitatively from that of other mammalian species observed under controlled conditions in laboratories. Changes in the number of the various cell types in the blood are more closely related to the typical clinical course of the radiation syndrome in man and ex-

perimental animals than any other response and the decrease in the number of lymphocytes in peripheral blood samples of man observed within 24 hours following exposure to doses of 100 to 450 R is considered to be one of the best biological dosimeters. (120 references) (CH)

15866 CURRENT TOPICS IN SPACE RADIATION BIOLOGY. Todd, P. (Pennsylvania State Univ., University Park); Tobias, C. A.; Silver, I. L. pp 583-606 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Topics discussed include: the possible hazards of handling artificial radiation sources used for power production in space (radioisotope-powered generators and nuclear reactors); results of experiments on the combined effects of gravity and radiation exposure on biological systems (Tribolium and Vicia); the heavy-ion exposure of astronauts in relation to phosphenes and light flares; and a review of Soviet data relevant to space radiation hazards and polices. (CH)

15867 RADIATION-INDUCED CORONARY ARTERY DISEASE. Tracy, G. P.; Brown, D. E.; Johnson, L. W.; Gottlieb, A. J. (SUNY Upstate Medical Center, Syracuse, NY). J. Amer. Med. Ass.; 228: No. 3, 1660-1662(24 Jun 1974).

A 35-year-old woman developed symptons of severe angina pectoris 19 months after radiotherapy to the mediastinum. The patient was shown to have extensive coronary artery disease by coronary angiography. Extensive exposure of the heart to radiation may pose an additional risk factor for the development of coronary vessel disease. (auth)

15868 PROCEEDINGS OF THE REGIONAL CONFERENCE ON RADIATION PROTECTION. Volume 2. Conference held in Jerusalem, Israel, March 5-8, 1973. Feige, Y.; Schlesinger, T. (eds.). Yavne, Israel; Soreq Nuclear Research Centre (1973). 406p. (CONF-730345-P2).

Separate abstracts were prepared for each of the 28 papers included under the following categories: reactor safety, regulations and population exposure, medical physics, and bioassay and internal contamination. (MCG)

For abstracts of individual papers see: 14850, 14851, 15063, 15374, 15375, 15626, 15869-15874, 16025-16029, 17466, 17482, 17483, 17736, 17776, 17777, 17981, 17982, and 18033-18035.

15869 CONCEPT OF MAN-REM: DEFINITIONS. Delpla, M. (Electricite de France, Paris). pp 569-589 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973). (In French).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The man-rem, a measuring unit more and more used because of its usefulness, is considered. In this field, an attempt is made to foresee what the damage will be for an irradiated population; more precisely, to reckon the numbers of cancers and detrimental mutations in an irradiated population. The author has recently proposed calling the sum of these numbers: Dommage Collectif Théorique (D.C.T.), i.e. theoretical collective damage. The D.C.T. calculation is based on the hypothesis of proportionally between accumulated dose equivalent and effect, that is to say between this dose equivalent and its corresponding risk for each individual in the population. From this hypothesis the accumulated dose equivalent is easily converted by means of an elementary formula into D.C.T. The author shows how the definition of man-rem, or rather (critical organ)-rem, can be deduced from this conversion formula, and that D.C.T., man-rem and its derived units, come from a misleading and dangerous concept. (auth)

15870 REDUCTION OF PATIENT DOSE IN DIAGNOSTIC RADIOLOGY. Donagi, A.; Hai, J.; Nave, M. (Ministry of Health, Tel Aviv, Israel). pp 641-653 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The problem of reducing patient dose in diagnostic radiology in Israel was approached from two angles: 1) nation-wide surveillance and control of radiation-producing machines and 2) reduction of patient dose by optimizing the conditions of operating the machines. The nation-wide supervision of x-ray machines is carried out by the Israel Ministry of Health as a public health service. The surveillance system covers all the x-ray institutions and dental clinics in the country, and its purpose is to reduce the radiation dose, both to patient and operator, to acceptable levels. Analysis of the data shows a marked reduction of the population exposure resulting from diagnostic x-ray procedures since the initiation of the surveillance system in 1966. This is in contrast to the increase in the population exposure which was noted in the period 1959 to 1966. Figures and estimates regarding the improvement of patient and operator protection in the x-ray institutes will be presented. In order to obtain the optimal operating conditions of the machines, a comprehensive study was performed aimed at reducing the patient radiation dose in diagnostic radiology. Chest PA, Abdomen AP and Lumbosacral L procedures were studied, while systematically varying various physical parameters, namely high voltage, added filtration, grid ratio, and intensifying screen speed. Skin dose, transmitted dose, and gonad dose were measured on a phantom. Altogether, a few thousand exposures using ionization chambers were made, as well as a few hundred actual exposures of various x-ray films. Optimal pictures for each combination of exposure conditions were selected and the skin dose, transmission ratio, and gonadal dose obtained were calculated. (auth)

15871 X-RAY DIAGNOSIS ASSOCIATED RADIATION EXPOSURE IN PUERTO RICO. Gileadi, A. E. (Puerto Rico Nuclear Center, Mayaguez); Gileadi, M.; Nater, C. E. pp 697-716 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

Based on data published within the framework of the Joint Radiation Survey-Puerto Rico potential health hazards and genetic effects associated with x-ray diagnosis in Puerto Rico were evaluated. Quantifiers used to describe the hazards both in magnitude as well as in frequency of occurrence include: 1) per capita per annum gonadal dose b) mean gonadal dose per procedure c) genetically significant dose (GSD). Genetically significant doses (GSD) were computed by means of the GSDPR-code, based on the PENFIL-BROWN formula and operative on the IBM 360/40 computer at the University of Puerto Rico, Mayaguez Campus. A detailed statistical study of abdominal and thoracic diagnostic x-ray procedures performed in Puerto Rico, as well as a rather extensive dosimetric study geared to determine the average gonadal dose associated with each diagnostic procedure considered, is described and relevant results presented. Measurements were performed both in vivo and on a Rando phantom. Instrumentation included Victoreen ion chambers, TLD-LiF powder dosimeters and high sensitivity DuPont SX-269 film packages, developed and read at Brookhaven National Laboratory. The dose reducing effect of testicular shielding was measured. Dose dependence on collimation characteristics was studied. A computerized cumulative dose recording system designed for use in Puerto Rico is discussed. (auth)

15872 DOSE DISTRIBUTIONS IN TANGENTIAL IRRADIATION OF THE CHEST WALL. Tatcher, M. (Rambam Univ. Hospital, Haifa, Israel); Cohen, Y.; Israeli, M.; Schlesinger, T.; Klopfer, Y. pp 717-720 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-73045-P2.

The dose distributions obtained when the chest wall is irradiated by a ^{60}Co tangential technique have been measured. The measurements were made with the aid of thermoluminescent ribbons and photographic films located in a pressed wood phantom. Internal and surface doses were determined for wedged and unwedged fields, with and without the addition of bolus material. (auth)

15873 RADIATION EXPOSURE DURING ANGIOGRAPHY. Poole, D. O. (Mt. Sinai Medical Centre, Miami Beach, FL). pp 721-730 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The dose equivalent in various critical organs is calculated per unit fluence normally incident on the body. Based on the recommendations of the ICRP, a series of graphs of annual maximum permissible fluence vs quanta energy is plotted. The response of various dose measuring systems is superimposed on these curves. The approach exposes the fallacy in equating dosimeter readings with "dose in the critical organ". (auth)

15874 RADIATION EXPOSURE TO THE FETUS FOLLOWING X-RAY EXAMINATION OF THE EXPECTANT MOTHER. Werner, A. (Sheba Medical Centre, Israel). pp 731-739 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The low level radiation doses resulting from diagnostic procedures cause great concern to all involved. On investigation of the accumulated evidence it appears that there is practically no chance that exposure in utero might cause congenital malformations. The chief concern is that of leukemia. This indication is based on follow-ups of the medical histories of mothers of leukemic children. It has been shown that a dose of 1 to 2 rads increases the incidence of leukemia from 1 : 3000 to 1 : 2000. (auth)

15875 SPACE RADIATION BIOLOGY AND RELATED TOPICS. Tobias, C. A.; Todd, P. (eds.). Monograph Series on Radiation Biology. New York; Academic Press, Inc. (1974). 561p. (TID-26574). $33.00.

Separate abstracts were prepared for each of the 13 chapters. (CH)

For abstracts of individual chapters see: 15756, 15757, 15765, 15780, 15781, 15863–15866, 15944, 15945, 16537, and 16902.

15876 SURGICAL TREATMENT OF RADIATION INJURY. Tsukada, S.; Akabane, N.; Yanagishita, K.; Yamamoto, M.; Miyanaga, S. (Kanazawa Univ., Japan). Rinsho Seikei Geka; 29: No. 1, 109-116(Jan 1974). (In Japanese).

Compared with the results by Robinson et al. statistically were 110 cases (age at initial examination, 1 to 73; 42 males and 68 females) of skin injury by radiation dealt with at the Department of Dermatology of School of Medicine of Kanazawa University in a period April 1961 to December 1971. Of those, 40 cases treated surgically were examined. Primary disease was malignant tumor in 53% and vascular tumor in 25%, the remainder being occupational accidents, tuberculous diseases, and cicatrical keloids. The irradiation source was ^{60}Co and radium in about 1/4 each, followed by x-ray, and then ^{90}Sr and ionizing radiation of betatron, including cases irradiated by two types of source. The dose irradiated could be confirmed in few cases. Twenty cases showed acute symptoms, and 90 chronic ones. The latter, subject to operation, consisted of 100% of dermatitis, 22% of ulcer, 9% of onset of tumor, 3% of osteonecrosis, and 8% of functional disturbances. Histological features of these symptoms were described. Surgical treatment was performed on five cases of occupational accident, 16 cases of benign tumor, 14 cases of malignant tumor, and five other cases. The primary disease, radiation source, chief symptoms of radiation injury, and surgical procedures of these cases were tabulated. Types of operation performed were free skin grafting in 27 cases, local flap in 13, remote flap in two, cylindrical flap in two, osteotomy diresis in three, nodal filling in one, and Tompson's operation in one. There are difficulties of resection in operation and bleeding, infection, and insufficiency as complications during and after operation. Dyskinesia was observed in cases of resection of carotid tissues where the vasculature gathers. None of the 40 cases died. Cases of radiation cancer underwent resection en bloc, and there has been no relapse during the five postoperative years. Based on the above, surgical treatment is necessary in cases of chronic radiation injury since various complications are liable in the future. (JA)

15877 RADIOTHERAPY OF MALIGNANT TUMOR AND RADIATION INJURY. Onoda, K. (National Toshizu Hospital, Japan). Nichidoku Iho; 18: No. 3, 413-420(Nov 1973). (In Japanese).

The following therapeutic plans were established for the radiotherapy of malignant tumor: confirmation of the radiosensitivity of malignant tumor cells; decision of the range and direction of irradiation by obtaining the size, site, infiltrative range, and metastatic circumstances of tumor; establishment of the dose distribution by time to minimize injury of the peripheral tissues; decision whether radical irradiation or palliative irradiation should be performed based on the progress of the malignant tumor and the general condition of the patient; and selection of the dose quality and instrument based on the site and depth of the tumor. The actual condition of radiotherapy described was 1000 patients with malignant tumor at National Tosei Hospital in the recent 5 years classified according to therapy and site. Presented were the actual conditions of cancer of uterine cervix and progressive pulmonary cancer for which radiotherapy is the radical treatment. Radiation injury was divided into general injury and local injury. Tabulated were hematological changes for the former and tolerant volume, 50% generation dose, and the number of months for the incidence after completion of irradiation for the latter. Various drugs were examined aimed at reducing radiation injury, treating the injury already present, elevating the radiosensitivity of malignant tumor, and maintaining the general condition of the patient satisfactorily. (JA)

15878 RADIOTHERAPY TRENDS IN JAPAN. At. Jap.; 17: No. 11, 24-28(Nov 1973).

The advantages of the use of radiation in medical practice in Japan are closely related to the special kinds of carcinoma most commonly found here as well as the specific conditions existing in this field of medicine in this country. The clinical application of oxygen effect, such as hyperbaric oxygen radiotherapy or radiotherapy under inhalation by the patients of 95% 0_2 + 5% CO_2 at atmospheric pressure, is being tested. The use of radiation, together with chemotherapeutic agents, is widespread in hospitals, and tumor immunization procedures combined with radiotherapy have reached the stage of clinical testing at some hospitals. There are five departments of radiobiology that belong to medical schools. These departments engage mainly in the study of radiation genetics and of radiation effects on DNA, and most of necessary studies concerning radiotherapy are left to clinical doctors. Also, studies using experimental animal tumors have been far from productive so far, because of weakness in breeding of inbred animals and of the lack of quantitative analysis methods of radiobiology. (JA)

15879 POPULATION EXPOSURE TO X RAYS: U. S. 1970. Nucl. Safety; 15: No. 4, 453-454(1974).

The entire summary section of the Public Health Service report on "Population Exposure to X Rays–U.S. 1970," DHEW (FDA) Publication 73-8047, is quoted. (MCG)

15880 SURGICAL GRAND ROUNDS: RADIATION ENTERITIS. Ill. Med. J.; 144: 567-569; 604(Dec 1973).

Side effects from postoperative radiotherapy are discussed. Endometrial carcinoma was treated by surgery and then pelvic irradiations of 6000 rads were carried out on two occasions. Late injuries to the small intestine are described. (MCG)

15881 A DOSIMETRIC STUDY OF THE "MANTLE FIELD" TECHNIQUE IN COBALT 60 TELETHERAPY. Habic, M.; Plesnicar, S.; Spaventi, S. (Ljubljana Univ. (Yugoslavia). Onkoloski Inst.; Zagreb Univ. (Yugoslavia)). Strahlentherapie; 147: No. 1, 41-44(Jan 1974).

3 figs.; 2 tabs.; 8 refs.

The purpose of the study is to evaluate the dose calculation methods for the "mantle field" technique used in the treatment of Hodgkin's disease. A comparison was made between the measured dose values and the dose values obtained by two different calculation methods. The study shows that the "off-axis" method gives better results than the "fragmented field" method. In a special case, the rectangular field was a better approximation of the "mantle field" than was a group of independent fields. (GE)

15882 COMPENSATION FOR RADIATION INJURY. Comments on a Court Decision. Devik, F. Tidsskr. Norske Laegforen.; 94: No. 14, 909-911(1974). (In Norwegian).

In 1958 a 29-year-old worker gave some assistance during industrial radiographic procedures. In 1959 his wife gave birth to twins. One lacked the left forearm, the other was stillborn. In 1965 the worker fell ill from chronic myelogenous leukemia and died in 1966. The worker claimed that the leukemia and the inborn defect were due to irradiation and sued his employer for compensation. It was estimated that the upper limit of the exposure was 10 R to the whole body and 40 R to the gonads. In December 1973 the court passed judgement in favour of the family of the deceased. The court found that the probabilities that the radiation doses were the causes of the leukemia and the malformation were over 50% and 50% respectively, and that, although the doses were in reality lower than the upper limits, the conclusion must be based on these estimates. It was also found that the deceased had not shown contributory negligence. The case is unique in the coincidence of three mutually independent and rare forms of injury which have all been related to the irradiation. It is probable that this coincidence has influenced the court's judgement in favor of the pursuers. It is then stated that this case underlines the need for adequate precautions and rules both for apparatus and operator. The relationship between dose and effect, and the probability of injury is then discussed. A previous article in the same journal is referred to (V. 94(6) p. 347-350, 28 Feb. 1974) and the necessity for caution in medical use of x rays is emphasized. (NO)

15883 EXPERIMENTAL USAGE OF CYTOCHROME C IN THE CASES WITH LEUCOPENIA DUE TO RADIATION THERAPY. Ohkawa, T. (Japanese Foundation for Cancer Research, Tokyo). Rinsho Hoshasen; 19: No. 2, 123-126(Feb 1974). (In Japanese).

Cytochrome C was used without the discontinuance of irradiation in the cases with leucopenia due to radiation therapy, and the effectiveness was studied. Subjects were selected as follows: I) 17 cases with irradiation after operation of the breast cancer, II) 6 cases with metastatic lung cancer, III) each 1 case with primary unknown cancer and with irradiation of the abdomen in relapse after operation of stomach cancer, IV) 2 cases in which leucopenia was seen during administration of Endoxan, 100 mg, per day after relapse of the breast cancer, and V) 3 cases in which the number of leukocytes was less than 2500 for a month

after irradiation of the operation of breast cancer. These patients orally received 30 mg of cytochrome C per day after each meal for 2 to 4 weeks. 4.3 MeV Linac x-ray was used as irradiation suppliment. Irradiation was effective for 20 of 25 cases (I, II, III) and was effective in all 5 cases (IV, V). Of all 30 cases, 12 cases (40%) were remarkably effective and 13 cases (43%) effective. In I group, statistical evaluation was done. The number of leukocytes showed the danger rate of less than 5% after administration (less than 1% after 1 and 2 weeks). Therefore, there was a significant increase, compared with those before administration. In the findings of leukocytes, the lymphocytes were significantly decreased. On the contrary, segment lymphocytes were increased. In addition, there was no significant variety in erythrocytes and liver function. There was no side effect in 30 cases. (JA)

15884 AFTER-LOADING FACILITY FOR GYNECOLOGICAL IRRADIATIONS. Bozoky, L. (Orszagos Onkologiai Intezet, Budapest); Csoke, A.; Lehoczky, G.; Rode, I. Izotoptechnika; 17: No. 4, 213-218(Apr 1974). (In Hungarian).

A pneumatically controlled after-loading facility, developed by the National Onkological Institute and the Central Research Institute for Physics of the Hungarian Academy of Sciences, is described. Use for handling γ implant sources for therapy of gynecological neoplasms is discussed. (tr-auth)

15885 CELL KINETIC PATTERNS IN HUMAN ACUTE LEUKEMIA: EVIDENCE FOR CONTROL MECHANISMS. Mauer, A. M.; Lampkin, B. C.; Evert, C. F.; McWilliams, N. B. (Univ. of Cincinnati). Bibl. Haematol.; No. 39, 1014-1021(1973).

The observed variation in the proportion of resting and proliferating leukemic cells in human acute leukemia from patient to patient and in the same patient during different phases of the disease gave indication of some internal control mechanism for the cell population's proliferative activity. Further studies of the effects of drugs and extracorporeal irradiation have given evidence that the population can be perturbed and manipulated from the outside. Resting cells can be brought into proliferative activity but also results of vincristine studies indicate that return of resting cells to cell cycle can be blocked. These studies with vincristine have also provided evidence for a true G_0 state for leukemic cells. These results need exploitation for increasing chemotherapeutic advantage. (auth)

15886 PRESENT STATE OF THE PROBLEM OF COMPREHENSIVE THERAPY OF ACUTE RADIATION SICKNESS. Munchev, N. Voenno Med. Delo; 28: No. 5, 3-9(1973). (In Russian).

The therapy of radiation sickness is discussed on the basis of extensive data taken from the literature. The administration of electrolyte solutions used to prevent dehydration and to maintain a normal acid-base balance, treatment with antibiotics to reduce bacterial invasion and bacteremia, administration of vitamins to combat avitaminosis, agents and methods applied to stimulate hemopoiesis, methods for counteracting the hemorrhagic syndrome, and other agents and methods used in the comprehensive therapy of radiation sickness are reviewed. It is stated that the therapeutic effect of nucleic acids (DNA and RNA) in acute radiation sickness, which has been established in animal experiments, is of particular interest. It is assumed that exogenous DNA acts as a substrate for DNA-ase and thus protects the own DNA of cells. As distinguished from transplantations of bone marrow, administration of DNA does not produce sensitization that gives rise to a secondary sickness. Administration of nucleic acids in combination with the transplantation of bone marrow is postulated as a promising method. (JPRS)

15887 APPLICATION OF CESIUM BOMB IN RADIOTHERAPY. Chvojka, Z. (Charles Univ., Hradec Kralove, Czech.). Lek. Zpr.; 17: No. 9-10, 201-204(1972). (In Czech).

A brief description of a ^{137}Cs γ source is presented and its application in radiotherapy is discussed. (INIS)

15888 RESPIRATORY CANCER MORTALITY IN AN IRON MINE IN NORTHERN SWEDEN. St. Clair Renard, K. G. (LKAB, Malmberget, Sweden). Ambio; 3: No. 2, 67-69(1974).

An essentially retrospective enquiry into the frequency of lung cancer has been undertaken in an iron ore mine in northern Sweden (Malmberget). The expected number of lung cancer cases during 1961 to 1972 was ca. 1.03, observed number was 14. The excess mortality in lung cancer is statistically related to underground mining. Other studies have shown a strong relation between radon-222 (and its decay products) and lung cancer. Relatively high levels of radon were found in the Malmberget mine, and may be the major causative factor. Smoking and other air pollution may also be contributing factors. (auth)

15889 RADIOACTIVITY OF TOBACCO TRICHOMES AND INSOLUBLE CIGARETTE SMOKE PARTICLES. Martell, E. A. (National Center for Atmospheric Research, Boulder, CO). Nature (London); 249: No. 5454, 215-217(17 May 1974).

It is found that airborne ^{210}Pb is concentrated on small particles that accumulate on tobacco trichomes. Tobacco curing and the combustion of trichomes in burning cigarettes produce insoluble particles of high ^{210}Pb radioactivity, which are inhaled and deposited in the bronchi of smokers. The subsequent ingrowth of ^{210}Po results in high local α irradiation, which may account for bronchial cancer among smokers. (auth)

15890 UP-TO-DATE DATA ON THE MUTAGENIC AND CYTOTOXIC PROPERTIES OF IRRADIATED FOODSTUFFS AND PRODUCTS. Shillinger, Yu. I.; Osipova, I. N. (Moscow Inst. of Power Supply). Vop. Pitan.; No. 5, 7-14(Sep 1973). (In Russian).

Literature data on mutagenic and cytotoxic properties of irradiated food, individual components of foods, food media, fodder, and plant food products are discussed. The results are of great interest in evaluating genetic hazards of human consumption of such products. (tr-auth)

15891 SKIN LESIONS DUE TO RADIOACTIVE PRODUCTS OF AN ATOMIC EXPLOSION AND SAFETY MEASURES. Chernenko, G. T.; Zhizhin, V. N.; Mal'kov, A. G.; Sakharov, I. F. Gig. Sanit.; No. 1, 76-82(Jan 1974). (In Russian).

The β dose delivered to the skin from the radioactive products of an atomic explosion is determined as a function of the time from the inception of exposure. The lesions caused are described as a function of the irradiation dose. Prophylactic measures are indicated. (JSR)

15892 CONDITIONS INFLUENCING THE INTEGRAL ABSORPTION DOSE IN THE ORGANISM OF ROENTGENODIAGNOSIS. Telichko, F. F. Med. Radiol.; 19: No. 5, 36-43(May 1974). (In Russian).

The rules characterizing the effect of voltage (50 to 100 kV), filtration (0 to 10 mm Al), irradiation area (100 to 1200 cm^2), and thickness of the object (5 to 30 cm) on the integral absorbed dose were studied with a consideration of those same factors on the quality of the image. (tr-auth)

15893 LOCAL AFFECTION IN IRRADIATION WITH ^{192}Ir. Krushkov, I. Kh.; Mikhailov, M. A.; Nacheva, V.; Ivanova, M.; Gospodinova, D.; Serafimov, A.; Kalchev, K. Ts. Med. Radiol.; 19: No. 5, 92-94(May 1974). (In Russian).

A case of the accidental irradiation with ^{192}Ir during the reloading of a defectoscope is reported. The injury resulting and the therapy followed are described in detail. (JSR)

15894 RADIATION SAFETY PROBLEMS IN PERSONS UNDER STUDY IN X-RAY EXAMINATION FOR DIAGNOSTIC PURPOSE. Krongauz, A. N.; Kazakova, L. N.; Gorelova, L. N.; Pavlova, T. G.; Khomutova, M. G. (Moscow Scientific-Research Roentgeno-Radiological Inst.). Vestn. Roentgenol. Radiol.; No. 2, 78-83(1974). (In Russian).

In the last decade there have been achievements in solution of the problem of reduction of radiation dose loads in diagnostic x-ray examinations of the population. In the course of these years the number of stationary x-ray units was more than doubled, and a series of new apparatuses and devices for x-ray examination of children providing high quality of x-ray diagnosis with the minimal radiation loads were developed. Intensifying screens promoting reduction of irradiation doses also were developed and are now widely used. Fluorography has become of ever greater significance in diagnostic x-ray studies and the use of roentgenography has doubled the last 10 years. A number of new roentgenographic diagnostic methods were developed and those known formerly were improved; the requirement to these methods with increase of their resolving powers assures the minimal radiation dose to the patient. (auth)

15895 RADIATION CONDITIONS AND LOCAL IRRADIATION DOSES OF MEDICAL PERSONNEL IN USING ELECTRON OPTICS IN X-RAY DIAGNOSIS OF CARDIOVASCULAR DISEASES. Zol'nikova, N. I.; Gas'maev, V. K.; Mamin, R. G. Vestn. Rentgenol. Radiol.; No. 2, 84-90(1974). (In Russian).

Dosimetric data are presented characterizing radiation conditions in contrast methods of x ray diagnosis of cardiovascular diseases with the use of electronic optic intensifiers, teleroentgenological systems, and cineroentgenological chambers. Irradiation dose rate in catheterization of the cardiac cavity and vessels proved to be 45 μR/sec for medical personnel. Results of individual photodosimetric control demonstrated that local irradiation doses for medical personnel could be considerable in case the dark room was used for more than 30 to 35 examinations a month. Irradiation doses of medical personnel (surgeons, anesthesiologists, paramedical workers) in various work regimen are presented. In roentgenoscopy regimen irradiation doses for physicians averaged 3 to 18 mb and for paramedical workers, from 3 to 10 mb per case examined by x-ray. In cineroentgenography,(coronarography) irra-

diation doses for the personnel ranged from 42 to 300 mb per patient studied. Local irradiation dose levels in single and serial large-frame roentgenograms are given. On the basis of the data obtained recommendations directed to reduction of radiation doses of medical personnel using in contrast methods of x-ray diagnosis of cardiovascular pathology are presented. (auth)

15896 THE EFFECT OF IONIZING RADIATION ON HUMANS. Nooteboom-Beckman, Z. M. (Stichting Reactor Centrum Nederland, The Hague). Ingenieur (The Hague); 86: No. 19, 362-365 (9 May 1974). (In Dutch).

The total natural dosage amount to approx. 93 mrad/yr, mainly from cosmic radiation and terrestrial sources; at 3000 m above sea level the cosmic ray component is doubled, but these levels still remain effectively harmless. Larger dosages are dangerous: a 200 rad dose has a 15% probability of causing death within 60 days, and a 400 rad dose 100%. An exposure of 1 rad/day leads to appreciable risks of leukemia and other cancers. Graphs are given of the % age of death or abnormalities resulting from a 200 R dose to the foetus at different stages in its development. (auth)

15897 KHIRUGICHESKOE LECHENIE PASLEDSTVII LUCHEVYKH CZHOGOV. (Surgical Treatment of the Sequelae of Radiation Burns). Polyakov, V. A.; Borisov, E. S.; Dmitrieva, V. S. Moscow; Meditsina (1974). 200p.

Observations are presented on 184 patients with after-effects of radiation burns. Problems of localized radiation damage (diagnosis, clinical condition, and treatment) are discussed from the viewpoint of the physician and surgeon. Following a literature survey and a short history of the study of radiation burns and a critical analysis of current classifications of local radiation damage, a new working classification of such burns and their after-effects is presented. The authors show that long incorrect treatment of radiation burns as dermatitis has led to generally conservative methods of treatment. However, conservative therapy has been shown to be not only ineffective but also indirectly the cause of complications. Therefore surgical intervention is preferred as the only method for radical cure of patients with long-standing ulcerations and scarring, complicated by transformation to malignant conditions. (tr-auth)

15898 IMPORTANCE OF THE AFTER-LOADING METHOD. The Development of a New Method for Oncoradiological Treatment. Rode, I. (Orvostovabbkepzo Intezet, Budapest). Izotoptechnika; 17: No. 4, 209-212(Apr 1974). (In Hungarian).

The development of a new after-loading method for γ radiation implant sources used for therapy of neoplasms is described. (tr-auth)

15899 PEACETIME RADIATION HAZARDS. Lunn, R. R. EMO (Emergency Meas. Organ.) Dig.; 13: No. 6, 1-3(Dec 1973).

The type of radiation hazard to be expected in peacetime is essentially an increase in the normal background radiation. Genetic considerations form the basis for the present radiation protection guide. Most protection effort is directed towards the prevention of accidents; a small percentage goes towards coping with accidents that may occur. (CA)

15900 EFFECTS OF PRIMOBOLAN-DEPOT UPON THE SIDE EFFECTS IN TREATMENT WITH RADIATION AND ANTICANCER AGENTS IN OTORHINOLARYNGOLOGICAL FIELD. Kinoshita, T. (National Hospital of Kumamoto, Japan). Nichidoku Iho; 18: No. 3, 526-529(Nov 1973). (In Japanese).

Results are reported from studies on the effects of Primobolan-Depot (an androgen) upon the blood picture in 33 patients with cancer of the upper jaw and cancer of the larynx who had received treatment with ^{60}Co γ irradiation administered at doses of 200 to 250 rads/week to a total dose of 3000 to 8000 rads, bleomycin, antibiotics, and vitamin therapy. (JA)

15901 EXPOSURE AND PROTECTION FROM RADIATION PRACTICE IN PEDIATRICS. Sakuma, S.; Ikunba, Y. (Nagoya City Univ., Japan). Shonika; 15: No. 1, 9-14(Jan 1974). (In Japanese).

An evaluation of the present degree of risk of ionizing radiation is outlined, and the internally absorbed dose in children and protective measures are examined with special reference to the reports of ICRP. The degree of risk of low-dose radiation is absolutely expressed with the number of persons injured by the unit dose predicted during the life of a group of 1,000,000 persons. In the case of acute exposure of less than 50 rad at a high dose rate, or divided exposures totalling a dose less than 10 rad per year, effects at issue are fetal exposure, genetic anomaly, induction of malignant tumor, and nonspecific shortening of life. The degree of risk of these problems was stated. Since fetuses and children are more radiosensitive than adults, the degree of risk for the onset of injury is high, and life shortening may result in long-surviving children. Of the significant genetic annual dose of a group, exposures during medical diagnostic procedures contribute the most, and measures for reducing this is necessary. In diagnostic radiography, since the probability that the sexual glands come directly in the radiation field, it is possible that the gonad dose is increased. On the assumption that the organ uptake rate of radioactive nuclides is the same as that of adults, the dose for their use is calculated for children. Since in newborns and infants below one year the proportion of the size of organs and the uptake rate differ from values in adults, they should be taken into consideration. Mentioned as the points of attention in the daily practice were to take x-ray films of good images, to minimize the area of radiation field, to improve the resolving power, not to use tube current of above 2 mA for fluoroscopy, and not to allow the dose rate to exceed 5 R/minute. Described were the geometric conditions of the x-ray tube, subject, and film in relation to x-ray transmissivity and radiation quality. (JA)

15902 DISTURBANCES OF HEMATOPOIETIC ORGAN DUE TO ATOMIC BOMB IRRADIATION. Ichimaru, M. (Nagasaki Univ., Japan). Rinsho Ketsueki; 14(Suppl.): 1255-1263(Dec 1973). (In Japanese).

Several cases of myeloproliferative disorders in atomic bomb survivors and the disturbances of hematopoietic organs, especially bone marrow, due to atomic bomb irradiation are discussed. One of the acute radiation effects was severe hypoplasia of bone marrow, which seemed to have either recovered soon or resulted in death within few months. Various myeloproliferative disorders were recognized as late effect of atomic bomb irradiation after some latent period, including the occurrence of leukemia. Besides leukemia, myeloproliferative disorders having disturbances of the erythropoietic series or megakaryopoietic series were also seen in survivors in Hiroshima and Nagasaki. Myelofibrosis was also seen. Following the recovery from hypoplastic marrow as an acute radiation effect, there was possibly no increase in the risk of aplastic anemia in atomic bomb survivors. Myeloproliferative disorders sometimes showed peripheral blood picture like aplastic anemia. (auth)

15903 OBSERVATION OF DEGRADED ROENTGEN RADIATION. Koren, K. (State Inst. of Radiation Hygiene, Oslo). pp 64-71 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

In the calculation of x radiation absorbed in specific organs or tissues in the human body, exact knowledge of the quality of the radiation in the volume of interest is indispensable. It is therefore of considerable interest to measure in detail the degradation of the incident beam once it has entered a medium of given composition and geometry. Such measurements can be carried out in several ways and have been described by various authors, but no complete data can be found and results that ought to be comparable show considerable discrepancies. Measurements based on the tandem principle, using two ionization chambers for each observation, are described. Of two geometrically identical chambers, one is made independent of the energy of the recorded radiation, while the other responds to the quality of the beam. In this way one obtains chamber readings that differ, and the discrepancies will depend on and can be used to reflect the energy of the radiation, here expressed as half value thickness. In the technique used, the least distorted results were obtained when: the chambers were small and spherical in order to detect radiation under 4π conditions; one chamber was made energy dependent by covering the inner electrode with Al foil. In this way the radiation is not filtered before detection and also the soft components of the radiation are detected because the binding energy of the K-electrons of Al is low and permits easy emission of photoelectrons in the chamber; both chambers are detechable from the reading instrument in order to have no metallic conductors in the observation volume; the chambers are irradiated first by exposing one chamber in the right position and afterwards repeating the exposure with the second chamber in exactly the same position, which gives the most spotlike observations of the half value thickness in the medium; and the phantom surrounding the observation volume was big enough for scattered radiation to build up fully. (auth)

15904 OCCUPATIONAL EXPOSURE: A REVIEW OF THE 1972 REPORT OF UNSCEAR. Sowby, F. D. (International Commission on Radiological Protection, Sutton, Eng.). pp 173-174 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The 1972 report of the United Nations Scientific Committee on the Effects of Atomic Radiation includes a section on doses from

occupational exposure. This updates the information presented by the Committee in its 1962 report. New data reported to UNSCEAR suggest that the number of radiation workers per thousand of population is between one and two. Most radiation workers receive very small exposures; the mean annual dose for most types of work appears to lie between 0.2 and 0.6 rad per year. However, considerably higher mean doses have been reported in certain types of work, notably industrial radiography. Nuclear power workers are currently exposed at about 2 to 3 man-rads per megawatt-year of electricity; this figure includes a contribution from nuclear fuel reprocessing. Estimates have been made of the contribution from occupational exposure to the genetically-significant dose to the population; at present this appears to be less than 1 millirad per year. Radiation injuries are now uncommon in most kinds of radiation work. However, occasional careless uses of radiation sources still result in accidents, particularly in industrial radiography, x-ray crystallography, and medical radiography involving the use of a hand-held fluoroscope. In underground mines, notably uranium mines, difficulty has been experienced in maintaining inhalation exposures below the levels recommended by ICRP. Some initial problems have also been experienced in the luminizing industry, following the introduction of tritium to replac radium. (auth)

15905 RADIATION EXPOSURE IN DENMARK. Grande, P.; Vig, B. (State Inst. of Radiation Hygiene, Copenhagen). pp 175-181 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Since 1964 a personal monitoring service, compulsory for all radiation workers, has been carried out in Denmark. Last year more than 9000 persons were monitored. Personal exposure for different groups is presented, as well as the total contribution to population exposure. Most exposed groups and the reasons for exposures are explained. A significant amount of false exposure occurs in the material (dose meter exposed but not the person). Approximately 25% of the high exposures are false. Contamination measured on personnel film wrapping paper gives a reliable warning about poor working habits in isotope laboratories, and is of considerable importance in the prevention of internal contamination. (auth)

15906 OCCUPATIONAL EXPOSURE IN ISRAEL. Avni, A.; Feige, Y. (Soreq Nuclear Research Centre, Yavne, Israel). pp 182-186 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The Israel Film Badge Service has been operating since 1957 and is now supervising about 4000 radiation workers. A single modified Hanford-type badge permits the evaluation of external x ray, gamma, and thermal neutron exposures. The service is supplied on demand, and is the only one available in Israel. Badges are supplied monthly, as a rule, but other arrangements for shorter or longer periods are also available. Data processing and reporting are performed automatically by means of a computer program written in COBOL. Exposure data for the years 1969 to 1972 are presented. From the results it appears that the annual average exposure of radiation workers in Israel is between 50 to 100 mrad, and that 90% of the workers received less than 150 mrad per year. The statistical significance of these results is discussed. Simple statistical evaluations seem to underestimate systematically the average occupational exposure. (auth)

15907 RADIATION EXPOSURE TO THE FINGERTIPS DURING GYNECOLOGICAL RADIUM APPLICATION. Van Dam, J.; Schonken, P.; Bonte, J.; Van Der Schueren, G. (Academisch Ziekenhuis St. Rafael, Leuven, Belg.). pp 207-216 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Results are presented of measurements made to assess the radiation exposure to the fingertips received by doctors and nurses during the gynecological application of ^{226}Ra implant sources. Thermoluminescent ribbons of TLD-100 were used for the estimation of dosage. A total of 17 cases of intracavitary radium applications were studied. The maximum amount of ^{226}Ra used in any one application was 120 mg. From these measurements, the number of radium applications that could be permitted during a period of one week was decided on the basis of the recommendations of the International Commission on Radiological Protection. Precision within ±2.5% could be achieved in the TL measurements. (auth)

15908 PROBLEM OF THE RISK RUN BY LOW DOSES OF IONIZING RADIATION. Vignes, S. (Electricite de France, Paris). pp 379-411 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973). (In French)

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The hazards to man from low doses of ionizing radiation are discussed. Data are reviewed from studies on laboratory animals of the somatic and genetic effects. Some observed facts on man and animal, which permit a better understanding of low-dose effects are reviewed. Topics discussed include: the influence exercised by dose rate, in x- and γ-irradiation, and also the influence of dose fractionation; the existence of a threshold dose, with regard to numerous somatic effects (lymphoma for mice, epithelioma, bone sarcoma and cataract, for men); the existence of a threshold dose rate for x- and γ-irradiation in relation to some pathologic effects on animals (examples are blood cells, immunity capacity, fecundity, and longevity) with the possible inverse effects below this threshold; and the existence of an active restoration process, which is as efficient in the genetic as in the somatic field, and also a selective process, particularly in genetics, which takes place at all the evolution stages of the gametes or eggs. The uncontrolled application of the proportional law, at very low doses is criticized in the light of past experiments. It is pointed out that the damage estimation based on this approach does not take into account either possible splitting up of dose (which is evaluated over a year), or dose rate, or the existence of restoration, which is often complete at low doses. (CH)

Vertebrates

Refer also to abstracts 15761, 15777, 15781, 15795, 15990, 15991, 16041, 16049, 16069, and 18109.

15909 (CONF-730228-, pp 425-446) SOME OBSERVATIONS ON THE ENZYMATIC HYDROXYLATION OF PHENYLALANINE AND PROLINE IN VIVO AND IN VITRO. Thyagarajan, P.; Vakil, U. K.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

Qualitative and quantitative changes in enzyme proteins and in urinary excretion of amino acids are known to result from a variety of nutritional and metabolic disturbances. Hydroxylation of phenylalanine and proline are among the reactions affected. Thus, a marked reduction in tissue collagen synthesis and an increased urinary excretion of phenylalanine are among the biochemical lesions in protein deficiency. This has been studied in greater detail in the vitamin A deficient rat, since mobilization of stored vitamin A is related to dietary protein level. It is observed that in the five week vitamin A-deficient rat, there is higher urinary excretion of phenylalanine and proline as compared to the pair-fed control, with concomitant drop in tyrosine and hydroxyproline values. Addition of retinol in vitro stimulates tyrosine synthesis from phenylalanine by a vitamin A-deficient rat liver enzyme preparation. Possible mechanisms are discussed. Similar to the effects of protein and vitamin A deficiencies, whole body x-irradiation (400 R) of the rat causes derangements in proline metabolism. Thus, following intraperitoneal administration of L-proline-U-^{14}C, there is decreased radioactivity in urinary hydroxyproline and changes in degradation rates of muscle collagen in the irradiated rat. These results correlate with the observed lower oxygen tension as well as altered lactate: pyruvate ratio in skeletal tissues; they are further substantiated by the observation that aerobic hydroxylation in vitro of peptidyl proline, prepared from 8 day-old chick embryo, by a liver enzyme preparation is not affected in the irradiated animal. (auth)

15910 (CONF-730228-, pp 681-689) CHANGES AT TRANSCRIPTIONAL LEVEL IN THE RAT LIVER FOLLOWING WHOLE-BODY X-IRRADIATION. Subba Rao, M. N.; Netrawali, M. S.; Pradhan, D. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

Whole-body exposure of rats to 1000 R x rays brings about a significant increase in the rate of RNA synthesis in the liver during 8 to 24 hrs post-irradiation. This stimulus has been found to be mainly the consequence of amplification in the template activity of chromatin rather than activation of RNA polymerase. Further experiments involving incorporation of labeled leucine into chromosomal proteins have revealed that during this period post-irradiation syntheses of certain acidic chromosomal proteins are specifically stimulated. All the observed changes at the transcriptional level can be suppressed if adrenals are removed from rats

prior to irradiation, indicating that these changes may have been elicited by increased output of adrenal steroids known to take place in response to whole-body radiation exposure. The results are discussed in the light of current concepts on the control of transcription in eukaryotes. (auth)

15911 (COO-3085-33) REGULATIONS OF ENZYMES IN ANIMALS: EFFECTS OF DEVELOPMENTAL PROCESSES, CANCER, AND RADIATION. Progress Report VIII, 1 May 1973–30 April 1974. Knox, W. E. (New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). Jun 1974. Contract AT(11-1)-3085. 16p. Dep. NTIS $4.00.

Systematic investigation of the quantitative and qualitative patterns of enzymes in numerous rat tissues was continued. Patterns of enzymes present in a variety of rat tissues were determined to such an extent that orderly relations among tissues can be precisely defined. Chief among these is the resemblance of tumors to one another (a prototypic tumor composition) and the relation of this type of composition to that of normal immature tissues. Chemical identification of tumor tissues by several analyses taken in combination is now possible, at least for groups of tissues. (CH)

15912 (CRSSA-1972) 1972 ANNUAL PROGRESS REPORT: SCIENTIFIC WORKS. (Centre de Recherches du Service de Sante des Armees, 75 – Paris (France)). 1972. 268p. (In French). Dep. NTIS (US Sales Only) $16.50.

Separate abstracts were prepared for 29 sections of this report. Abstracts of two papers appeared in NSA previously as numbers 28: 30076 and 29: 05355. (CH)

For abstracts of individual sections see: 15913–15930, 15982, 15988, 16011–16013, and 16034–16039.

15913 (CRSSA-1972, pp 20-21) VARIATIONS IN THE PLASMATIC AMINO-PEPTIDASE LEUCINE LEVEL IN RABBITS AFTER γ IRRADIATION. Breuil, L.; Servant, P.; Follezou, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The variations observed in the plasma leucine level of rabbits subjected to 450 rads (50% LD) of γ irradiation were studied. An attempt was made to explain these variations in terms of a concomitant variation in the amino-peptidase leucine level. Only very small variation, which did not prove very useful for estimating radiobiological damage, were observed. Other experiments are currently being conducted at higher dose levels (650 rads) in order to discover whether more significant variations can be observed. (FR)

15914 (CRSSA-1972, pp 21-23) VARIATIONS IN THE PLASMATIC CORTISOL LEVEL IN RABBITS AFTER γ IRRADIATION. Breuil, L.; Servant, P.; Lefort des Ylouses, D. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The cortisolemia of rabbits γ irradiated with 450 rads (LD 50%) was studied. A peak in the cortisol secretion level was observed 3 hours after whole-body or cephalic irradiation. (FR)

15915 (CRSSA-1972, pp 23-24) EFFECT OF A SEMI-LETHAL WHOLE-BODY γ IRRADIATION ON INTRAVENOUSLY PROVOKED HYPERGLYCEMIA IN RABBITS. Sentenac-Roumanou, H.; Mamou, J.; Bourguignon, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Research was conducted on the disturbances occurring in the glucide metabolism of rabbits subjected to whole-body γ radiations (450 rads). Special attention was given to the problem of eliminating fasting effects. A reduction in the glucose assimilation coefficient, K, was observed in the case of hyperglycemia in rabbits 24 hours after a semi-lethal whole-body irradiation. Systematic studies on fasting animals cast doubts on the validity of the results obtained in post irradiation biochemical analyses. Computer studies on the result of provoked hyperglycemia enabled the radioprotecting powers of certain substances to be investigated. (FR)

15916 (CRSSA-1972, pp 24-26) URIC AND HIPPURIC ACIDS. Assays and Method for Studying their Excretion in Rat Urine. Valle, C. (CEA, Fontenay-aux-Roses, France); Duprey, F. 1972. (In French).

The urine of rats exposed to whole-body irradiations was analyzed. The existence of metabolites (whose level depends on the amount of irradiation received) was established. An attempt was made to identify the metabolites most suitable for providing a rapid and reliable evaluation of the biological damage which had occurred. The results obtained for uric and hippuric acid are explained, the explanation being incomplete for the latter. A significant increase in the uric acid excreted occurs immediately after irradiation. The present state of experimentation is insufficient to allow the determination of the survival or mortality rate from such measurements. The hippuric acid excretion rate dropped by a factor of 2 for rats surviving irradiation. Because after irradiation, some animals eat more and some less, systematic studies were carried out on fasting animals. Fasting produces the same effect as irradiation in the case of hippuric acid (reduction in the level excreted). In the case of uric acid, fasting produces a reduction in the level excreted; this level increases under the effect of irradiation. Preliminary results on the excretion of these two substances show that they are strongly affected by γ irradiation. (FR)

15917 (CRSSA-1972, pp 27-31) CHANGES OCCURRING IN THE SPONTANEOUS ELECTRICAL ACTIVITY OF THE BRAINS OF ADULT RABBITS SUBJECTED TO WHOLE-BODY γ IRRADIATION. Court, L. (Ministere des Armees, Paris); Dufour, R.; Bassant, M. H.; Fatome, M.; Roulf, G. 1972. (In French).

The effect of whole-body γ irradiation doses of 850, 650, 450 and 250 rads on the spontaneous cerebral electrical activity of adult rabbits was analyzed. The modifications produced in the cerebral excitability manifest themselves as anomalies in the energy content of the EEG signals, these changes occurring very rapidly after the irradiation. The dorsal hippocampus, which presents regular quasi-periodic activities during vigilance does not, after irradiation, present its normal fundamental frequencies. The rapidity with which such changes occur might be explained by the direct effect of these irradiations on particular cerebral structures and neuron metabolism. (FR)

15918 (CRSSA-1972, pp 31-34) MODIFICATIONS IN THE ELECTRICAL ACTIVITY OF THE HYPOTHALAMUS OF ADULT RABBITS GIVEN WHOLE-BODY IRRADIATIONS. Lasmoles, F. (Ministere des Armees, Paris); Court, L.; Dufour, R.; Bassant, M. H. 1972. (In French).

The effect of a whole-body γ-irradiation (doses of between 650 and 250 rads) on the spontaneous electrical activity of different hypothalamus structures and their energy contents was studied. Investigations of the corresponding EEG traces confirm previous results. The same anomalies are found in the cortex and the dorsal hyppocampus (clusters of large amplitude slow activities or point grapho-paroxystic activities) which remain isolated, or which diffuse into the rest of the encephalic structures. An increase in energy in the 18 to 40 Hz band width range was observed in the mesencephalic reticular formation region, this energy increase contrasting with the energy drop occurring in the supraoptic nucleus and mammillary body. These properties tend to confirm the hypothesis that a whole-body irradiation provokes a stimulation of the hypothalamus under the direct effect of an influx convergence originating from the trunk of the brain. On the other hand, the low frequency energy increases can be interpreted in terms of inhibiting effects as is the case for the cortex. (FR)

15919 (CRSSA-1972, pp 37-38) EFFECT OF IRRADIATIONS IN INHIBITING NEO-NATAL TOLERANCE INDUCED IN RABBITS. Servant, P.; Hacquin, A. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

An attempt was made to determine the effect of whole-body irradiation on the establishment of a state of tolerance in new-born rabbits by the intraperitoneal injection of 1 mg of human serum albumin. Simultaneous irradiation (100 to 250 rads) and antigen injections inhibited the establishment of this tolerance. (FR)

15920 (CRSSA-1972, pp 38-40) EFFECT OF IRRADIATION ON RABBIT IMMUNOGLOBULINS. Semi-Quantitative Assays Using Immunoelectrophoresis. Lebas, J.; Servant, P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The effect of γ irradiation on rabbit immunoglobulins was studied. The animals were divided into three groups: those subjected to encephalic irradiation; those subjected to whole-body irradiation (450 rads); nonirradiated reference animals. The three groups were given injections of human serum albumin (2.5 mg) 24 hours after irradiation. The variations in the level of immunoglobulins were studied using the semi-quantitative immunoelectrophoresis technique. Nonirradiated reference animals did not exhibit significant variations in their immunoglobulin levels. Irradiated animals exhibited a constant increase peak between the 3rd and 24th hour following the irradiation, the recovery time being about 1 month. A comparable process was observed with the encephalically irradiated animals: a peak increase followed by a drop. The basis level, nevertheless, appeared to be reached more quickly. (FR)

15921 (CRSSA-1972, pp 43-45) ULTRASTRUCTURAL STUDY OF IRRADIATION EFFECTS ON THE PERIOSTEUM ACTIVITY IN MICE AFTER A FRACTURE. Drouet, J.; Baron, R.; Deloince, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

An ultrastructural study was effected of the periosteum of mice over a period of seven days following a combined fracture–whole-body-irradiation (700 rads) lesion. Inactivation of the periosteum cells was observed together with the appearance of capillary and

arteriole lesions. These important vascular lesions are most probably partly responsible for the momentaneous stopping of the periosteum activity. (FR)

15922 (CRSSA-1972, pp 46-48) STUDY OF THE CONSOLIDATION IN VITRO OF FRACTURES OF THE BONES OF IRRADIATED ANIMALS. Nguyen, T. L.; Drouet, J.; Fournie, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Results are presented of histological studies made of the changes occurring in vitro to the long bones of irradiated mice (x radiation doses up to 10000 rads) after their extraction, fracture, and immersion in culture media. The delay in consolidation increased with increasing dose although the basic repair processes remain unchanged. (FR)

15923 (CRSSA-1972, pp 49-52) CLINICAL AND BIOLOGICAL ASPECTS OF CUTANEOUS BURNS OF IRRADIATED RATS. Nguyen, T. L.; Mazmanian, G.; Wagnon, N.; Hanout, R.; Neveux, Y.; Drouet, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Rats were subjected to a double injury (a thermal burn and irradiation). The burn inflicted was of the third degree and covered about 10% of the body surface. Gamma irradiation (700 rads) was performed 4 hours after the burn and been inflicted. The clinical and biological syndromes presented by these animals are compared with those exhibited by animals subjected to only irradiation. It was observed that the burn did not aggravate the developments taking place as a result of the irradiation and that the most important prognostic was due to the irradiation only. (FR)

15924 (CRSSA-1972, pp 103-105) DIFFERENT CELL TYPES. Deloince, R.; Baron, R.; Drouet, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

A preliminary ultrastructural study was carried out on fracture stimulated periosteum cells of mice prior to experiments on the cytological modifications occurring in the joining of bone tissue as a result of whole-body irradiation. Three types of cells found in the periosteum are described: cells that are long and narrow having high nucleocytoplasm ratios; large cells in the bulk of the periosteum having lower nucleocytoplasm ratios; large cells having irregular contours and very low nucleocytoplasm ratios, which form the innermost layer of the periosteum along the length of the bone. (FR)

15925 (CRSSA-1972, pp 155-157) EFFECT OF TRIPLET STATES ON THE OXYGEN ENHANCEMENT EFFECT. Studies with Hydroquinone. Fontenil, L.; Rocquet, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The part played by hydroquinone triplet states in photolytic oxidation was verified by increasing the hydroquinone $S_1 \rightarrow T_1$ conversion ratio under ultraviolet excitation by the addition of potassium iodide, or lithium bromide during radiolysis. These compounds increase the singlet triplet conversion rate which subsequently leads to a corresponding increase in the oxidation rate. This increase in photochemical oxidation is particularly sharp in the presence of lithium bromide. It, nevertheless, still remains necessary to establish the effect of these triplet states on the radiobiological oxygen enhancement effect. (FR)

15926 (CRSSA-1972, pp 161-164) OXYGEN ENHANCEMENT EFFECT AND THE ADENYL CYCLASE ACTIVITY OF THE PLASMIC MEMBRANES OF RAT LIVERS. Rocquet, G.; Kergonou, J. F.; Tine, J. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The adenyl cyclase system of rat liver membranes can be activated by glucagon and fluorine ions. When such a system is exposed to γ radiation, its activity diminishes as a function of the absorbed dose. It was suggested that this reduction in activity might be due to an alteration in the phospholipid membranes resulting from the formation of lipidic peroxides. This hypothesis was confirmed from the results of examinations of the effect of oxygen on the decay in adenyl cyclase activity during γ irradiation. The oxygen enhancement effect was more significant in the case of the glucagon activity than in the case of the fluorine activity. This difference can be explained by the different chemical nature of the sites: phospholipidic receptor sites for glucagon; catalyptic protein sites for fluorine. The presence of oxygen changes the form of the curves obtained: in the presence of oxygen, irradiation inactivates the adenyl cyclase in a relatively short period of time; in the absence of oxygen irradiation inactivation the adenyl cyclase after a certain latent time has elapsed. Several hypotheses were put forward to explain this latent period: in the absence of oxygen, the inactivation takes place in at least two stages; the oxygen, which is initially absent, forms during the irradiation giving rise to a latent oxygen enhancement effect. (FR)

15927 (CRSSA-1972, pp 192-194) RADIOPROTECTING POWER OF BENZOFURANNIC DERIVATIVES. Fatome, M.; Frossard, H.; Bernard, P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The radioprotective properties of the benzofuran series was studied in irradiated mice. Most benzofuran derivatives have significant radioprotecting properties. Particular attention was given to the position 6 derivatives of 2,3-dimethyl 4,7-dihydroxy benzofuran and to some of the corresponding dimethyl ethers. (FR)

15928 (CRSSA-1972, pp 194-195) RADIOPROTECTING EFFECT OF C_{511} INJECTED INTO MICE 24 HOURS BEFORE A LETHAL DOSE IRRADIATION. Fatome, M.; Frossard, H. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The duration of the effectiveness of C_{511} was demonstrated together with its low level of toxicity. When C_{511} was injected into mice 24 hr before a whole-body irradiation with γ radiation (LD 100%/30 days). It was observed that this substance protected 40% of the animals. (FR)

15929 (CRSSA-1972, pp 196-197) DETAILED STUDY OF THE ACTION OF RADIOPROTECTING SUBSTANCES: WEIGHING OF THE SPLEEN AND COUNTING OF SPLEEN CLONES. Fatome, M.; Frossard, H. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Two tests were used in a detailed study of the effectiveness of radioprotecting substances (cysteamine, serotonin, C_{511}, AET, WR638, and WR2529): counting of the spleen clones; weighing of the spleen. Studies were carried out on the weight of mice spleens 4 days after exposing animals to infra-lethal doses of x-rays. The spleens were weighed immediately after their removal. This test gave values for the Dose Reduction Factors (DRF) which were of the same order as those obtained with 30 day lethal dose experiments. Clone counting tests were performed 8 days after irradiation. Dose reduction factors smaller than those measured in 30 day lethal dose experiments were obtained. The results demonstrate that the protection afforded to the hematopoietic cells does not entirely explain the radioprotecting properties of the products. In the case of serotonin, the protection given to the hematopoietic cells is small. On the other hand, a greater amount of protection is provided by cysteamine and C_{511}, above all for small doses of radiation. (FR)

15930 (CRSSA-1972, pp 197-199) EFFECT OF SEROTONIN ON THE SPONTANEOUS AND EVOKED CEREBRAL ACTIVITY OF NORMAL ADULT RABBITS SUBJECTED TO A LETHAL WHOLE-BODY IRRADIATION. Fatome, M.; Court, L. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The radioprotective effect of serotonin on the central nervous system of rabbits exposed to 650 rads of whole-body irradiation was studied. The intravenous injection of 10 mg/kg of serotonin into these animals either stopped or considerably reduced the radiation induced hyperexcitability. A much smaller increase in total signal energy was observed after irradiation with serotonin protected animals than with nonprotected animals. This property, by reducing the disturbances in the peripheral organs, may partly explain some of the radioprotecting power of this substance. (FR)

15931 (NP-20045) ANNUAL REPORT, VOLUME 21. (Nagoya Univ. (Japan). Research Inst. of Environmental Medicine). 1974. 79p. Dep. NTIS (US Sales Only) $7.00.

Separate abstracts were prepared for two sections of this report. Seven additional sections report results of other studies on the effects of environmental factors on the physiology of experimental animals. (CH)

For abstracts of individual sections see: 15932 and 15933.

15932 (NP-20045, pp 67-70) EFFECTS OF LOW-DOSE X-RADIATION ON THE DEVELOPING BRAIN OF MOUSE FETUS. Effects of X-radiation on the Cell Cycle of Matrix Cells in the Telencephalon of 10-day Mouse Embryo. Hoshino, K.; Hayashi, Y.; Nakane, K.; Kameyama, Y. 1974.

In order to elucidate the effects of prenatal x-radiation, especially of low-dose radiation, on the developing brain of mouse fetuses, changes in the cell cycle of matrix cells in the telencephalon following x-irradiation were examined employing ^{3}H-thymidine autoradiography. (auth)

15933 (NP-20045, pp 71-76) LONG-TERM PATHOLOGICAL EFFECTS OF PRENATAL X-RADIATION ON THE DEVELOPING BRAIN. Abnormal Vascular Formation in the Brain Mantle of the Mouse Fetus Caused by X-radiation (the Second Report). Hayashi, Y.; Hoshino, K.; Kameyama, Y. 1974.

A mouse embryo irradiated with 200 R of x-radiation on day 13 of gestation showed an inhibition of capillary formation in the

brain mantle one or two days after radiation. The early changes in vascular formation were examined with an electron microscope and are described. (auth)

15934 (RLO-2225-T-16-10) LYMPHOCYTE FORMATION, LIFE SPAN, FATE, AND POTENTIAL FOR REPOPULATING HEMOPOIETIC TISSUES OF IRRADIATED ANIMALS. Progress Report for the Year 1973–1974. (Washington Univ., Seattle (USA). School of Medicine). 1974. Contract AT(45-1)-2225. 9p. Dep. NTIS $4.00.

Progress is reported on studies of lymphocyte formation, life span, and repopulation in hemopoietic tissues of irradiated animals. Results are summarized for studies on the origin and life span of long-lived small lymphocytes in the bone marrow of x-irradiated mice, the uptake of ^{3}H-deoxycytidine used as a tracer for DNA synthesis by cells of the thymus, lymph nodes, and spleen of mice, and studies of hemoglobin synthesis at the cellular level in guinea pigs in which ^{55}Fe was used as a tracer for autoradiographic studies. A list is included of 13 papers published during the period covered by this report that present the results of completed studies. (CH)

15935 (SGAE-2240) QUALITATIVE AND QUANTITATIVE AUTORADIOGRAPHIC INVESTIGATIONS ABOUT DNA-REPAIR IN THE PARS OPTICA RETINA OF RABBITS. Kellner, G.; Reindl, E.; Pichler, L.; Hofer, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Biologie). Jan 1974. 14p. (In German). Dep. NTIS (US Sales Only) $4.00.

In vitro and in vivo investigations into the incorporation of ^{3}H-thymidine into the nuclei of pars optica retinae of rabbits after irradiation with 60 krad were performed. The results of the in vitro and in vivo experiments are comparable with the in vitro data showing smaller statistical deviations. The rate of incorporation of ^{3}H-thymidine into the nuclei of Ganglion opticum and Ganglion retinae is about the same, but it is significantly lower in the nuclei of photoreceptor cells by one order of magnitude. The in vitro experiment demonstrates that ganglion cells are capable of DNA repair even after circulation has been stopped for 15 or more minutes. (auth)

15936 (UCD-472-120, pp 18-20) CONTINUOUS GAMMA-RAY AND FRACTIONATED X-RAY EXPOSURES ON THE OVARY OF THE YOUNG PUP: PRELIMINARY REPORT. Anderson, A. C.; Momeni, M. H. Jun 1973.

In annual report, fiscal year 1973.

Both continuous (5 R/day) γ and fractionated x radiation exposures of 10 R on alternate days to young pups from 2 to 60 days of age caused severe ovarian damage. At 4 months of age the ovaries of 3 pups in each group contained an abundance of nongerminal epithelioid cells and a sparse number of follicles. (auth)

15937 (UCD-472-120, pp 21-27) EFFECTS OF FRACTIONATED X-RAY AND CONTINUOUS GAMMA-RAY EXPOSURES ON THE FETAL MONKEY (MACACA RADIATA): PRELIMINARY REPORT. Andersen, A. C.; Momeni, M. H.; Hendrickx, A. G.; Johnson, M. I. Jun 1973.

In annual report, fiscal year 1973.

An experiment involving 50 prenatally irradiated bonnet monkeys is in progress. Currently 1 male and 2 female irradiated monkeys are alive and 4 adults are due to give birth. One stillborn female gives evidence that the ovary is seriously damaged by 11.5 rads γ radiation given twice weekly, 80 to 136 days post-coitum (total 200 rads). In another stillborn the ovary was not damaged by the same x ray dose delivered 48 to 104 days postcoitum. Testicular damage by irradiation is being investigated. (auth)

15938 (UCD-472-120, pp 28-33) X RADIOSENSITIVITY OF INTERSTITIAL TISSUE IN THE OVARY OF THE BEAGLE. Andersen, A. C.; Simpson, M. E. Jun 1973.

In annual report, fiscal year 1973.

Cells in the medulla of the ovary in the adult Beagle were identified as being analogous to interstitial tissue of other species on the basis of their response to human chorionic gonadotropin (HCG). Similar cells in the afollicular ovary of x-irradiated Beagles likewise responded to HCG. HCG caused a two-fold increase in size of the afollicular ovary and in the diameter of the uterus. The response to HCG of the afollicular ovary points to a possible function of this tissue in the dog. (auth)

15939 (UCD-472-120, pp 45-49) HEMATOLOGIC EFFECTS OF CONTINUOUS ^{60}Co EXPOSURE ON WEANLINGS AND YOUNG ADULT BEAGLES: INTERRELATIONS WITH THE EFFECTS OF INTERNAL EMITTERS. Waterman, D. D.; Chrisp, C. E.; Momeni, M. H.; Wilson, F. D.; Rosenblatt, L. S. Jun 1973.

In annual report, fiscal year 1973.

Serial blood and bone marrow samples were examined on a pilot group of Beagles receiving continuous ^{60}Co γ irradiation as weanlings. The data provide guidelines for structuring future studies of effects of continuous low-level, whole-body ^{60}Co γ irradiation of Beagles. (auth)

15940 (UCD-472-120, pp 115-117) TRANSPLANTATION OF A SPONTANEOUS MYELOGENOUS LEUKEMIA: COMPARISON WITH RADIOINDUCED LEUKEMIAS. Shifrine, M.; Wilson, F. D.; Chrisp, C. E.; Waterman, D. D.; McNeill, C. J.; Wolf, H. G.; Taylor, N. J.; Holloway, G. L. Jun 1973.

In annual report, fiscal year 1973.

Transplantation studies in dogs using a spontaneous myelogenous leukemia were compared with similar studies using radiation-induced leukemias. Cytogenetic analysis suggested that the spontaneous leukemia was virally transmitted in one recipient. (auth)

15941 (UCD-472-120, pp 123-125) LYSOZYME ACTIVITY IN RADIATION-INDUCED TRANSPLANTATION CASES AND SPONTANEOUS CANINE MYELOGENOUS LEUKEMIAS. Shifrine, M.; Chrisp, C. E.; Wilson, F. D. Jun 1973.

In annual report, fiscal year 1973.

Serum samples from 17 dogs with spontaneous or radioinduced myelogenous and myelomonocytic leukemia contained high concentrations of lysozyme (63 to 450 μg/ml). Sera from 50 clinically normal dogs and 46 non-leukemic dogs with a variety of clinical conditions, including pyogenic infectious disease, contained significantly less lysozyme (mean values of 5.2 and 10.7 μg/ml, respectively). Four dogs with lymphosarcoma had normal lysozyme levels, an indication that lysozyme determinations may be useful in the differential diagnosis of canine leukemias. The availability of a canine model of myelomonocytic leukemia provides an opportunity to study the significance of serum lysozyme levels under various conditions. (auth)

15942 (UCD-472-120, pp 137-139) EFFECTS OF ^{131}I AND X IRRADIATION ON BEAGLE PUPS. Book, S. A.; Bustad, L. K. Jun 1973.

In annual report, fiscal year 1973.

The effects of irradiation of the thyroid of 4-month-old Beagles from 1500 rads from internal ^{131}I with or without 200 R from whole-body x irradiation or 4500 rads from internal ^{131}I are discussed about 5 yr post-irradiation. Only the 4500-rad group showed marked changes in tracer uptake, with depressed peak uptake and rapid release. In general, effective half-lives (T_e) of control animals were longer than those of the 1500 rad and 1500 rad + 200 R groups, and the T_e of males exceeded that of females. Serum TSH was within the normal range. (auth)

15943 (UCD-472-120, pp 158-161) EFFECTS OF RADIATION AND DISEASE STATE ON SERUM TRACE ELEMENT HOMEOSTASIS IN BEAGLES. Fisher, G. L.; Gray, G. M.; Batzel, S. Jun 1973.

In annual report, fiscal year 1973.

Radiation and neoplastic history were found to significantly affect the distribution of serum trace elements (Cu, Zn, Fe) (in Beagles.) Significant differences were observed in inter-element correlation coefficients for several parameters. (auth)

15944 CIRCADIAN RHYTHMOMETRY OF MAMMALIAN RADIOSENSITIVITY. Haus, E. (St. Paul-Ramsey Hospital and Medical Center); Halberg, F.; Loken, M. K.; Kim, Y. S. pp 435-474 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Data are reviewed from studies on circadian cycles in the biological response of mice and hamsters to x irradiation and seasonal variations in the radiosensitivity of mice and rats. Other biological responses to circadian rhythm in rodents are discussed and the effects of genetic strain, diet, infections, and environmental factors, such as housing and light, on circadian fluctuations in radiosensitivity of rodents are examined. It is concluded that extrapolation of the findings to the response of astronauts to radiations encountered during space flight is not warranted and the circadian response of each astronaut must be determined on an individual basis. (120 references) (CH)

15945 MATHEMATICAL MODELS OF MAMMALIAN RADIATION RESPONSE FOR SPACE APPLICATIONS. Steward, P. (Washington Univ., St. Louis). pp 523-564 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Biological models for the recovery of mammals from radiation injuries are discussed. Biological models of mammalian aging are discussed in relation to their application in studies on radiation-induced aging. Applications of these models in the development of a mathematical formalism to indicate quantitatively the risk to astronauts from radiation exposure while following an arbitrary dose-time schedule. (50 references) (CH)

15946 EFFECTS OF IRRADIATION ON THE CENTRAL NERVOUS SYSTEM. Tsuya, A. (Japanese Foundation for Cancer

Research, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 12, 925-967(Dec 1973). (In Japanese).

Disturbances of the central nervous system due to radiotherapy are described. Results of the investigation by questionnaire on radiation myelopathy in Japan are reported. Dose and the size of field in all cases obtained by questionnaire are shown. The latent period was distributed widely in from 2 to 3 months to 15 to 38 months, and its peak was recognized in 12 to 24 months. Long latent period was suggested to be a characteristic of nerve disturbances. Four cases of malignant tumor who survived for a long time after irradiation were studied by routine and evoked electromyographies. All 4 cases of radiation myelopathy showed abnormalities indicating upper motor neuron disturbances due to irradiation in both electromyographies. Abnormal findings were recognized with a high rate in cases showing some nervous symptoms during irradiation, and after that, manifestation of radiation myelopathy was recognized. Effects of head irradiation on glycolysis were observed by using $^{14}CO_2$ as an indicator, which was expired in breathing air within 2 hours after ^{14}C-U-glucose and ^{14}C-1-acetic acid were injected into rats intraperitoneally. Early, profound dose-dependent depression of glycolysis was found markedly in whole organs. Depression of glycolysis phase due to irradiation was recognized in the anaerobic phase of glycolysis, but the aerobic phase was promoted inversively. Effects of irradiation on electroencephalogram are described. (JA)

15947 KINETICS AND PROLIFERATIVE ACTIVITY OF STEM HEMOPOIETIC CELLS IN THE ORGANIC CULTURES OF INTACT AND RAPIDLY PROLIFERATING BONE MARROW OF ADULT MICE. Rakcheev, A. M. Probl. Gematol. Pereliv. Krovi; 18: 38-44(Oct 1973). (In Russian).

The number of stem hemopoietic cells (CFU), of the living cells and the level of proliferative activity of CFU was studied in the organic culture of regenerating bone marrow obtained either from the early radiation chimerae or from the sublethally irradiated (250 R) adult mice. Despite the preservation of a high level of proliferative activity of CFU (the value of "thymidine suicide"—42—53%) the absolute count of CFU as per one hip displayed a rapid fall. Some elevation of the duration of hemopoiesis and a less pronounced decrease of CFU and of the living cells (in comparison with analogous indices obtained in examination of bone marrow cultures of intact mice or bone marrow of early radiation chimerae) were revealed in case of bone marrow explantation from sublethally irradiated mice. (auth)

15948 REACTIVITY OF IRRADIATED ORGANISM TO ANALGESICS. Kovalcik, V.; Zabojnikova, M. (Komenskeho Univ., Bratislava). Folia Fac. Med. Univ. Comenianae Bratislav.; 10: No. 2, 183-229(1972). (In Slovak).

The efficiency of analgesics, both narcotic and non-narcotic, was studied in whole-body x-irradiated mice and rats to find whether or not the reactivity of the organism to analgesics changes as a result of irradiation. Investigated were morphine, pethidine, and methadone as typical narcotics, and aminopyrine as a typical non-narcotic analgesic. In various tests carried out at various intervals following exposure, the assumption was confirmed that irradiation does not significantly affect the efficiency of the analgesics studied, as the reactivity changes of the irradiated organisms were not statistically significant. (INIS)

15949 MATERNAL INFLUENCE ON RESPONSIVENESS OF MULTIPAROUS MICE TO THE ANTIGENIC CHARACTERISTICS OF THEIR MALE PROGENY. Uphoff, D. E. (National Cancer Inst., Bethesda, MD). J. Nat. Cancer Inst.; 52: No. 6, 1843-1847(Jun 1974).

To test the maternal influence on responsiveness of multiparous mice to antigens controlled by the Y chromosome, the survival of lethally irradiated ovatransfer substrain males inoculated with syngeneic maternal marrow was compared with the survival of similar groups from the strain of origin and the strain of the ancestral foster mother. Multiparity may result in sensitization of the mother to the antigens of her male progeny; this is indicated by the reduced survival of lethally irradiated male recipients of maternal bone marrow. Either an increase or a decrease in responsiveness was transferred from the strain of the ancestral foster mother, depending on whether this strain was more or less responsive than the strain of origin of the ova-transfer substrain. The responsiveness of the ova-transfer substrains differed from both ancestral strains, even when these strains showed similar maternal responses to the antigens of their male progeny. Although sensitization through multiparity was required to detect these differences in responsiveness to these relatively weak antigens, the shift in responsiveness described in this test system was similar to that observed in other test systems involving a primary response toward histocompatibility-2 antigens. (auth)

15950 EFFECTS OF NEUTRON RADIATION ON THE WOUND RESPONSE OF THE RAT LENS EPITHELIUM. Austin, B. T. Iowa City, IA; University of Iowa (1973). 87p. University Microfilms Order No. 74-7351.

Thesis (Ph. D.).

The primary objective of this study was to characterize some effects of a single, cataractogenic dose of fast neutron radiation on the proliferative capabilities of intermitotic cells in the rat lens epithelium and to investigate the functional recovery of these cells after irradiation. The ability of the cells to respond to the mitogenic stimulus of mechanical wounding at selected intervals after irradiation was used as a measure of both radiation effect and recovery. About 14 hours after mechanical injury in the central zone (anterior polar region) of the unirradiated rat lens epithelium, many of the intermitotic cells around the wound began DNA synthesis. A synchronous increase in the mitotic activity of these cells occurred about 10 hours later. Some effects of a single 200 rad dose of fission neutron radiation on the response to wounding have been characterized. This study was designed to provide quantitative information comparable to that which had previously been obtained utilizing a single 1000 rad dose of x-radiation. Holtzman rats, approximately 3.5 months of age at the time of irradiation, were used as experimental and control animals. The eyes of experimental animals were irradiated with 200 rad of fission neutrons in the high flux irradiation cell of the JANUS Irradiation Facility located at Argonne National Laboratory. One hour, 3 days, 7 days or 30 days after irradiation, a small puncture wound was made at the anterior pole of the lens in both eyes of anesthetized experimental and control animals. At various times ranging from 12 to 36 hours after wounding, tritiated thymidine (5 μCi, 1.9 Ci/mmole) was topically applied to the cornea of experimental and control animals. Lenses were sampled 2 hours after the labeling procedure for determination of labeling and mitotic indices. At times when only mitotic activity was to be quantified, both experimental and control animals were sacrificed without prior labeling. In general, the effect of a single, 200 rad dose of fast neutron radiation on the wound response of the rat lens epithelium resembled the effect of a single 1000 rad dose of x-radiation. In each case, DNA synthesis in the responding cells, quantified by determining the percentage of cells that had incorporated tritiated thymidine, was depressed and delayed. Mitotic activity was similarly affected. As the interval between irradiation and wounding was lengthened, less delay of the response was observed. At 30 days after irradiation, no delay in the onset of the response was observed. A qualitative difference in the recovery of the peak percentage of cells labeled was noted during the first 7 days after irradiation. After x-irradiation, the peak number of labeled cells progressively increased; 6, 8, and 12% were labeled when wounded 1 hour, 3 days, and 7 days after irradiation, respectively. After neutron-irradiation, the value remained constant at 8 to 9% labeled cells. The percentages of abnormal mitotic figures observed after irradiation and wounding also indicated that recovery from the effects of x-radiation progressed more rapidly than recovery from neutron radiation effects. At 30 days after irradiation, neutron and x-irradiated epithelia still showed residual depression of the wound response and some mitotic abnormalities. From these observations, it was inferred that some effects of neutron and x-irradiation differed and that some of the biological damage of neutron radiation, effects resulting in depression of the peak response, required a longer time for repair than the biologically comparable damage caused by x-radiation. The inference is consistent with earlier observations that there was little recovery from the effects of neutron radiation when dose fractions were given at weekly (or shorter) intervals and that the late effects of the neutron radiation were more severe than was predicted on the basis of effects observed immediately following neutron or x-irradiation. (Diss. Abstr. Int., B)

15951 NORMAL AND MALIGNANT TISSUE RESPONSE TO FRACTIONATED RADIATION EXPOSURE AND THE RADIOPROTECTIVE DRUG WR-2721. Echols, F. S. Gainesville, FL; University of Florida (1973). 140p. University Microfilms Order No. 74-9596.

Thesis (Ph. D.).

The radioprotective drug, WR-2721, was administered to mice at a dose of 200 mg drug for each kg of body weight 15 minutes prior to each 1 through 10 exposure fractions. In both mouse strains tested, BALB/c and RFM, the drug increased the resistance of the mice to skin injury following single exposures by a factor of 1.67 to 1.98. However, as the number of treatment fractions increased, a slight reduction in protective effectiveness was noted. In spite of this decrease in protective ability, WR-2721 was still able to increase the resistance of the skin by more than 1000 to 2000 rads under the treatment methods studied. WR-2721 was also tested for its ability to protect two different tumor

types, the mammary carcinoma and the lung adenoma, in the BALB/c and RFM mice respectively. The mammary carcinoma was induced in the BALB/c mice via subcutaneous injection of a tumor cell suspension in the dorsal thorax region. The tumor growth was then treated with 1 through 10 exposures of x-radiation and transplanted into recipient mice. The radiation-induced inhibition of tumor transplantability was noted for control and drug treated groups. In addition, the volumes of the tumors were measured prior to transplantation. Lung adenomas were induced via an intraperitoneal injection of 1.0 g of urethane per kg of body weight. The RFM mice were later treated with 1 through 9 exposures of gamma radiation from a Cs-137 source to the lung only. Later, the mice were sacrificed and the number and volume of tumors per mouse were determined. In both the mammary carcinoma and the lung adenoma tumor systems, the radioprotective drug, WR-2721, was found to offer no significant protection to the malignant tissue. This fact, taken in conjunction with the results of the normal tissue study, indicates that WR-2721 offers a definite possibility of improving the efficiency of clinical radiation therapy of solid tumors due to the differential chemoprotection of normal and malignant tissues. The effects of the administration of radiation to the tumors were studied by evaluating the reduction of the tumor volume as a function of both the total dose given and the number of radiation dose treatment fractions employed. An empirical formula was derived which served to describe the observed tumor response. The results indicated that the present traditional methods for treatment planning are simply inadequate, and that tumor system modeling can result in an increase in the efficiency of radiation therapy. (Diss. Abstr. Int., B)

15952 INCLUSION OF THE LUNGS AND OF SOME LYMPHOID ORGANS INTO THE PROCESSES OF ANTIBODYGENESIS IN IRRADIATION OF ANIMALS. Kevorkov, N. N.; Ravich-Shcherbo, M. I. (Kursk Medical Inst., USSR). Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 9, 80-84(Sep 1973). (In Russian).

Gamma irradiation of rabbits at doses of 1000 R completely inhibited immune reactions in the spleen and lymph nodes, but had no effect on the production of hemagglutinins by lung tissues. Antibody formation was completely suppressed in all organs studied. (CH)

15953 EFFECT OF INOCULATION OF BURSA CELLS ON THE SPLENIC LYMPHOID TISSUE OF BURSECTOMIZED AND X-IRRADIATED CHICKENS. Hoshi, H. (Tohoku Univ., Sendai). Tohoku J. Exp. Med.; 108: No. 2, 113-121(Oct 1972).

Bursectomized and x-irradiated chickens were given intraperitoneal inoculation of live bursa cells in an attempt to restore the periellipsoidal lymphoid cells in their spleens. An injection of viable cells prepared from autologous bursae into neonatally bursectomized and x-irradiated chickens produced no recognizable restoration of the bursa-dependent lymphoid elements, i.e., periellipsoidal lymphoid cells, germinal center cells, and plasma cells. A slight restorative effect was found by inoculations on the 8th and 9th days of a large number of homologous bursa cells, which were obtained from newly hatched or 4-week-old chickens. In the chickens that were bursectomized, x-irradiated, and given their own unirradiated bursa cells at around 2 weeks of age, all the bursa-dependent elements including the periellipsoidal lymphoid cells were found considerably restored. The result shown by the 2-week-old chickens was thought to provide a circumstantial support for the concept that the periellipsoidal lymphoid cells may be one of the cell lineages stemming from the bursal lymphoid cells. (auth)

15954 EFFECT OF ^{60}Co IRRADIATION ON THE MUCOUS MEMBRANE OF THE PARANASAL SINUS OF NORMAL RABBITS. Uchida, T. (Nagoya City Univ., Japan). Nagoya Shiritsu Daigaku Igakkai Zasshi; 24: No. 1, 67-89(May 1973). (In Japanese).

Rabbits, four weeks of age, were given general irradiation with ^{60}Co, and the effect on turnover time of the mucous epithelium of the paranasal sinus was studied by autoradiography using labeled ^{3}H-thymidine. Turnover time was 12 to 14 days in the normal group and the group irradiated to 100 R and about 20 days in the group irradiated to 500 R. Labeling rate was low in the irradiated groups as compared to the normal group, and inhibition of cell division increased with increasing dose. Effects of local irradiation with ^{60}Co on the mucous membrane of the paranasal sinus of rabbits was studied. The dose used 300 R per irradiation. The animals were irradiated every day and divided into groups according to total dose size: 1500, 3000, 4500, 6000, 7500, 9000, 10500, 12000, 13500, and 15000 R. The leucocyte count showed a 26% decrease in the group irradiated to 10500 R and a 50% decrease in the group irradiated to 15000 R. As changes of skin, erythema was recognized in the groups irradiated to more than 6000 R, dry exfoliation change and hair loss in the groups irradiated to more than 7500 R, and white lichenification erythematous, edematous scale and crust formation in the groups irradiated to more than 10500 R. Histopathological change of the mucous membrane of the paranasal sinus was also discussed. Swelling of a part of the epithelial cells was recognized in the group irradiated to 7500 R, and a tendency of multilayers formation and proliferation of goblet cells was recognized in the groups irradiated to more than 9000 R. In the groups irradiated to 9000 to 12000 R, alcianophila in epithelial cells and glandular cells was recognized. In the group irradiated to 15000 R, proliferation of epithelial cells which showed atypical type was observed. In glandular tissues, marked degeneration of glandular epithelium was recognized in the group irradiated to 9000 to 12000 R, and a part of the group irradiated to 7500 to 13500 R showed mucous alcianophila. In the group irradiated to more than 9000 R, appearance of bone necrosis and new bone formation were observed and fibrosis of interstitial tissue was observed in the group irradiated to more than 13500 R. (JA)

15955 PROTECTION FROM HAEMOPOIETIC DEATH BY SHIELDING VERSUS GRAFTING OF BONE MARROW. Van Bekkum, D. W.; Schotman, E. (Gezondheidsorganisatie TNO Rijswijk, Netherlands). Int. J. Radiat. Biol.; 25: No. 4, 361-372(Apr 1974).

The efficacy of shielded bone-marrow cells versus injected bone-marrow cells for hemopoietic restoration of lethally-irradiated mice was reinvestigated. Three different end-points were employed. Spleen weight at 10 days after irradiation was used instead of spleen-colony count, because of the difficulty encountered in enumeration of endogenous spleen colonies. Repopulation of the unshielded femur at day 10 after irradiation was used as a second end-point, since the colonization pattern of endogenous surviving cells might be directed to parts of the hemopoietic systems other than the spleen. As a third end-point, 30-day survival of lethally-irradiated animals was used, which required a two-phase irradiation to avoid changes in mortality pattern caused by the immobilization during irradiation. The results obtained by all three methods indicate that endogenous surviving cells are at least equally effective in repopulating the hemopoietic tissues as grafted bone-marrow cells. (auth)

15956 ESTIMATION OF DOSE TO THE HEMATOPOIETIC SYSTEM IN RATS EXPOSED TO WHOLE-BODY IRRADIATION OF FOUR X-RAY ENERGIES AND ITS APPLICATION TO LETHALITY. Maillie, H. D.; Krecidlo, L.; Lopez, O. (Rochester Univ., NY). Health Phys.; 27: No. 1, 126-128(Jul 1974).

Following previous work (Maillie and Mermagen, Health Phys.; 20: 179 (1971), Maillie et al, Health Phys.; 22: 394 (1972)) in which a relationship was demonstrated between radiation dose and iron uptake in bones of rats (including spinal and long-bones) at four incident x-ray energies, further work is reported here. The method was applied in estimating the dose to all of the bones in rats receiving whole-body exposures from 80, 150, 250, and 1000 kVp x rays. To test the usefulness of this method of dose estimation groups of 16 to 20 rats were exposed to varying midline air exposures of the four x-ray energies in a lethality study. Based on dose estimations obtained the $LD_{50/30}$ were determined for each incident x-ray energy. It is concluded that this method offers a reasonable estimate of the dose delivered to the active bone marrow of the rat with the results having the standard errors of the mean of less than plus or minus 10% in most cases. (UK)

15957 RBE OF CYCLOTRON FAST NEUTRONS FOR INTERPHASE DEATH IN RAT THYMOCYTES IN VITRO. Geraci, J. P.; Thrower, P. D.; Jackson, K. L.; Christensen, G. H.; Fox, M. S. (Univ. of Washington, Seattle). Int. J. Radiat. Biol.; 25: No. 4, 403-405(Apr 1974).

The viability of rat thymocytes, a non-dividing cell population in vitro, was compared after fast neutron and x irradiation. Viability was demonstrated by the incorporation of ^{3}H-labelled adenine into the cells. No difference was observed between the best-fit curves of survival versus neutron or x-ray dose, yielding an RBE of 1.0 with a 95% confidence interval of 0.9 to 1.1. It is suggested that since other workers' results have yielded an RBE for thymus-cell loss in vivo of 2.3, it is the RBE for reproductive death in lymphoid tissue which exceeds one. It is concluded that if this is the case, the neutron RBE for cure of various types of lymphoid tumor will depend on the relative contribution of interphase death and reproductive death to tumor sterilization. (UK)

15958 ANALYSIS OF THE STICKING PERIOD OF CHROMOSOMES IN MAMMALIAN CELLS IN VITRO AND SOME PROBLEMS AFFECTING THE FORMATION OF STRUCTURAL MUTATIONS. Demin, Yu. S.; Elisova, T. V. (Inst. of Biology of Development, Moscow). Sov. Genet. (Engl. Transl.); 7: No. 5, 605-612(May 1971).

Translated from Genetika; 7: No. 5, 69-77(May 1971).

Chromosomal aberrations were studied in mammalian cells during the first hours after the action of radiation, i.e., in the sticking period of the chromosomes. The frequency of adhesions

of chromosomes is shown to correlate with the frequency of exchange aberrations (translocations, isolocus breaks). It can be concluded from analysis of the dynamics of chromosomal adhesions and chromosomal aberrations and also on the basis of cytological observations that the formation of chromosomal aberrations is a process which requires a certain period of time. Adhesion of chromosomes is a stage in the formation of a chromosomal aberration of the exchange type. (auth)

15959 INTERACTION OF CELLS TRANSPLANTED TO SYNGENIC AND ALLOGENIC RECIPIENTS DURING IMMUNE RESPONSE TO HETEROLOGOUS ERYTHROCYTES. Gambarov, S. S.; Golovistikov, I. N. (Inst. of Medical Genetics, Moscow). Byull. Eksp. Biol. Med.; 76: 109-112(Sep 1973). (In Russian).

The interaction of the bone marrow cells with the thymus and lymph node cells of the CBA and C57BL/6 mice during the production of plaque-forming cells synthesizing antibodies against sheep erythrocytes was studied under condition of the cells' transplantation to lethally irradiated syngenic recipients or to their hybrids (CBA × C57BL/6) F_1. It was established that the phenomenon of allogenic inhibition of the stem hemopoietic cells might cause the immune response depression in the interaction of cells transplanted to heterogenous recipients. (auth)

15960 INTERACTIONS BETWEEN DIFFERENTIATION AND LEUKEMOGENESIS IN RAUSCHER MURINE LEUKEMIA. Brommer, E. J. P.; Bentvelzen, P. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Bibl. Haematol.; No. 39, 929-934(1973).

In erythroblastosis induced by Rauscher murine leukaemia virus, normally functioning haemopoietic stem cells are present, capable of restoring lethally irradiated mice. In the spleen the number of pluripotent stem cells has increased considerably. Absorbed rabbit antiserum to the virus is cytotoxic to the stem cells in leukemic spleens, indicating the presence of viral antigens on the surface of these cells. Sensitivity of the leukemic stem cell to normal rabbit serum has decreased strongly. Not only erythropoietic but also antigenic and thrombopoietic stimuli promote the splenomegaly induced by the virus. The radio-sensitivity of the leukemic response resembles that of the pluripotent stem cell. It was postulated that the virus infects the hemopoietic system at the level of the stem cell; transformation requires a differentiating stimulus. (auth)

15961 CHARACTERISTICS OF COMBINED RADIATION AFFECTIONS DUE TO GENERAL γ-IRRADIATION AND INTERNAL IRRADIATION WITH SMALL DOSES OF ^{131}I. Vasilenko, I. Ya.; Klemparskaya, N. N.; Klassovskii, Yu. A.; Lagun, M. A.; Kaganov, V. M.; Miloserdov, A. P.; Il'chenko, E. F.; Pavlenko, A. A.; Krasnokutskii, V. M. Gig. Sanit.; No. 5, 34-38(May 1974). (In Russian).

Experimental data obtained show that general external γ-irradiation in a dose of 50 R and local irradiation of the thyroid gland with ^{131}I in a dose of 200 rad in case of separate and combined action produced no acute radiation disease in dogs and may be considered to be tolerable under extraordinary conditions. (auth)

15962 RELATIVE AND ABSOLUTE GOBLET CELL NUMBERS IN INTESTINAL CRYPTS FOLLOWING IRRADIATION OR ACTINOMYCIN D. Cooper, J. W. (Allegheny General Hospital, Pittsburgh). Experientia; 30: No. 5, 549-550(15 May 1974).

Mice were irradiated, abdomen only, with 600 R of x radiation (HVL 1.8 mm copper). Groups of 5 mice were sacrificed at 8 through 96 hr post-irradiation, and samples taken from the lower ileum were examined microscopically for crypt and goblet cells. In the second experiment, mice were injected i.p. with actinomycin D, 750 μg/kg body weight, and crypt squash preparations were examined as before. Total cells and total goblet cells per crypt were determined for 20 crypts per animal for both experiments. The relative number of goblet cells for each animal was determined by dividing goblet cells/crypt by total cells/crypt (expressed as percent). Following 600 R of x radiation, total cells per crypt were decreased for the first 48 h post-exposure, and by 96 h the crypt was in a hyperplastic state. Total goblet cells also decreased for the same period, but not as drastically as total crypt cells. The result was an increase in the percentage of crypt cells which were goblet cells. A similar pattern was seen following administration of actinomycin D, but recovery was delayed about 1 day in comparison with x radiation. The maximum goblet cell percentage therefore occurred 1 day after the peak with x-radiation. This phenomenon is explained by differences in sensitivity between crypt cell populations. (CH)

15963 DEVELOPMENTAL RETINOPATHY IN THE RAT INDUCED BY DIAGNOSTIC-QUALITY X-IRRADIATION. Mock, B. H. Lafayette, IN; Purdue University (1973). 149p. University Microfilms Order No. 74-5018.

Thesis (Ph.D.).

The morphological effect of diagnostic-quality x-rays (140 kVp, 2.35 mm Al HVL) on the developing fetal and postnatal rat retina was studied by using light and electron microscopy. Since a major concern of the study was the induction of permanent retinal injury which might affect vision in the adult animal, microscopic examination of the irradiated retina was largely confined to day 14 postnatal. Due to the fact that the x-ray beam had an effective energy in air of only 30 kV, it was important to determine the degree of exposure reduction of fetuses in utero caused by maternal tissue shielding. Accordingly, lithium fluoride thermoluminescent dosimeter rods were implanted in selected day 17 fetuses of pregnant rat cadavers and the apparent x-ray exposures measured relative to the skin-surface exposure given the adult animal. A nearly 30% reduction was found. Retinas from animals which were irradiated in utero on day 17 of gestation with an apparent x-ray exposure of 70 R (100 R skin-surface exposure) were found to contain no visible radiation-induced abnormalities when examined microscopically on day 8 and 14 postnatal. Although it cannot be stated that the irradiation had no effect at all on the fetal retina, the results obtained do support the conclusion that the 70 R apparent x-ray exposure had no visible effect on the development of the adult retina. Different litters of postnatal rats were exposed to 100 R x-rays on each of the first seven days of life. Examination on day 8 and 14 postnatal with light and electron microscopy revealed that the postnatal retina was also insensitive to the induction of permanent retinal injury even at the 100 R exposure level. No visible abnormalities were demonstrated in any of the retinal layers that could be attributed to the effect of the irradiation. To state conclusively that a threshold exposure greater than 100 R exists for the induction of permanent retinal injury by diagnostic-quality x-rays required the demonstration of true radiation-induced retinal injury at some higher exposure level. Accordingly, littermates were exposed on either day 3 or 4 postnatal to either 200, 300, or 500 R of x-rays. Examination revealed quite clearly the presence of severe dysplasia within the outer layers of the sensory retina at each exposure level. (Diss. Abstr. Int.,B)

15964 RADIATION EFFECTS ON ALLOSTERIC ENZYMES. Yamada, T.; Oyama, H. (National Inst. of Radiological Science, Chiba, Japan). Hoshasen Seibutsu Kenkyu; 8: No. 3, 57-66(Sep 1973). (In Japanese).

Disturbances in the metabolism of cells play an important role in cell injury caused by irradiation of the living body. These disturbances were found to be caused by changes of the allosteric activity, one of the metabolism modulating, rate-determining enzymes. The data of studies by which this discovery was obtained were shown, and the outcome of studies of radiation effects on allosteric enzymes done by other groups is reviewed. It was found that as a phosphofructokinase (PFK), several of whose isoenzymes were confirmed to be present in the tissue of the laboratory mammals, the thymus-type enzyme extracted from thymal cells and refined was more strongly allosteric by far than the pre-existing muscle-type enzymes. On this thymus-type PFK, effect of irradiation on catalytic activity was examined, but x irradiation at doses up to 10 kR produced no effect under the optimal conditions (pH 8.0, F6P, ATP 1mM) of this enzyme. However, under the same conditions as the intracellular ones, 1 to 2 mM of ATP, rise of the enzyme activity dependent on the irradiated dose occurred; activation of 30 to 45% by irradiation with 500 R to 1 kR, and a rise of activity 2 times and 5 times with 5 kR to 10 kR. It was concluded that changes in the allosteric effect of the protein itself of the PFK enzyme induced lowering of sensitivity to ATP inhibition, resulting in a rise of the activity under the intracellular conditions. (JA)

15965 CHROMOSOMAL ANOMALIES IN MICE, SPONTANEOUS AND ARTIFICIALLY INDUCED BY IONIZING RADIATIONS AND CHEMICAL MUTAGENS. Leonard, A. Louvain, Belgium; Univ. Louvain ([nd]). 145p. (In French). Centre d'Etude de l'Energie Nucleaire, Mol, Belgium.

Thesis.

Changes in chromosomes in spermatogonia of x-irradiated mice were studied. The chromosomes of the normal mouse spermatogonia are described, and the different types of anomalies that can be found in this species are reviewed. The production of various chromosome anomalies by exposure to ionizing radiation is discussed. The induction of chromosome anomalies by chemical mutagens is also discussed. (tr-auth)

15966 MECHANISM OF RADIATION-PROTECTION ACTION OF DIMETHYL SULFOXIDE. Goncharenko, E. N.; Burlakova, E. V.; Zhat'koba, G. S.; Samoilikova, T. I.; Dzhanumova, T. G. (Moscow State Univ.). Biol. Nauki; 120: 45-47(1973). (In Russian).

The radioprophylactic effect due to the administration of dimethyl sulfoxide to white mice was accompanied by an increase in the endogenic radiation protective substances, serotonin, histamine, and dopamine, in the tissues and a decrease in the ac-

tivity of the biogenic radiation sensibilizators of the phospholipid type. The changes were similar to those seen in the action of radiation protectors of other chemical types and quantitatively resembled the effect due to preparations with average protective properties. (tr-auth)

15967 MECHANISM OF RADIATION-SENSITIZING ACTION OF BETA-MERCAPTOETHANOL. Vogatyrev, G. P.; Goncharenko, E. N.; Zhat'kova, G. S.; Kudryashov, Yu. B.; Chirkov, Yu. Yu. (Moscow State Univ.). Biol. Nauki; 115: 54-56(1973). (In Russian).

Possible mechanisms of the radiation sensitizing action of β-mercaptoethanol based on the hypothesis of biochemical background of radiation resistance were studied. It was shown that the administration of β-mercaptoethanol to rats caused a decrease in their tissues and organs of the endogenic radiation protectors, histamine, dopamine, serotonin, and loosely bound phospholipids, and an increased level of endogenic radiation sensitizers, the lipid oxidation products. (tr-auth)

15968 ENHANCEMENT OF RADIATION EFFECTS BY HEATING OF THE TUMOR. Har-Kedar, I. (Sheba Medical Center, Israel); Yerushalmi, A. pp 440-453 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Experimental and clinical studies showed that heat may enhance the effect of radiation on the growth of malignant tumors. A radiation therapy technique that allows regional and selective irradiation plus heating of the tumor region is described. An accurate system of continuous monitoring of peritumor, intratumor, and total-body temperature was used, on mice with well established viral fibrosarcoma of the limb. In successive experiments four treatment groups were compared: intratumor heat at 42°C; 800 R radiation; radiation combined with heat; and a control group. There was clear evidence of an enhancing effect of heat, additive or synergistic, when used with radiation therapy. (auth)

Invertebrates

Refer also to abstract 15780.

15969 (UCR-34-P-105-29) DIFFERENTIAL RADIOSENSITIVITY IN GERM CELLS OF DROSOPHILA. Progress Report, 1969-1974. Parker, D. R. (California Univ., Riverside (USA)). 1974. 16p. Dep. NTIS $4.00.

Progress is reported on the following research projects: analysis of half-translocations detaching attached-X chromosomes; nondisjunction of fourth chromosomes in compound-X females; effect of an enlarged distributive pairing pool; X chromosome loss correlated with fourth chromosome gain; time of occurrence of radioinduced nondisjunction; segregation following interchange in mature oocytes; meiotic geometry and aberration formation; and induced crossing-over. (HLW)

15970 HORN FLIES: EMERGENCE, SURVIVAL, AND STERILITY AFTER ^{60}Co IRRADIATION OF PUPAE. Chamberlain, W. F. (Agric. Research Service, Kerrville, TX). J. Econ. Entomol.; 67: No. 3, 381-383(Jun 1974).

Irradiation of colony-reared 30-h-old pupae of Haematobia irritans (L.) with 2500 rad from ^{60}Co completely inhibited emergence of flies; with irradiation of 54-h-old pupae, some flies emerged, but all died within 3 days. When 78-h-old pupae were irradiated, unusual numbers of adults died within 3 days. However, when pupae were 102 or 126 h old at the time of irradiation, neither emergence nor survival of flies was affected adversely. Also, when this dose was applied after emergence had begun (avg pupal age 120 h), both males and females were sterile. With a dose of 2000 rad, the females were sterile, and fewer than 1.0% of the males were fertile. Male flies eclosing during the initial 24 h of the emergence period accounted for most of this fertility. (auth)

15971 GAMMA IRRADIATION FOR CONTROL OF INSECTS IN WHEAT FLOUR. Tilton, E. W.; Brower, J. H.; Cogburn, R. R. (Agric. Research Service, Savannah, GA). J. Econ. Entomol.; 67: No. 3, 430-432(Jun 1974).

When naturally or artificially infested wheat flour was packed in metal cans or multiwall paper bags and treated with doses of gamma irradiation ranging from 31.8 to 48.0 krad, populations of mixed stages and species of insects were not eliminated within 1 month. However, doses averaging as low as 15.0 krad did cause 100% mortality within 3 months of irradiation among eggs and young larvae of those species most likely to be present in flour. The results showed that if mortality of all eggs and young larvae is to be complete by the end of 1 month, the dose selected must be higher than the maximum dose used in the tests reported here. (auth)

15972 SUPPRESSION OF POPULATIONS OF TOBACCO BUDWORMS CAGED WITH STERILE FEMALES. Guerra, A. A.; Garcia, R. D.; De La Rosa, H. H. (Agriculture Research Service, Brownsville, TX). J. Econ. Entomol.; 67: No. 3, 333-334 (Jun 1974).

Field-cage releases of adult female Heliothis virescens (F.) reared on larval diets containing reserpine and irradiated as pupae with 20 krad of gamma irradiation reduced the F_1 larval generation ca. 70% from that of the check when the ratio of releases was 9:1 irradiated to unirradiated. Releases of both sexes of irradiated insects at the same ratios reduced F_1 larval populations ca. 39%. An additional reduction was obtained when irradiated females were released into populations of F_1 moths. The fecundity of P_1 and F_1 moths was reduced 18 and 28%, respectively, when irradiated females were released once and 33 and 42% when they were released twice. (auth)

15973 DETERMINATION OF QUANTITATIVE SPERM TRANSFER BY MALE TOBACCO BUDWORMS IRRADIATED AT DIFFERENT AGES. Raulston, J. R.; Graham, H. M. (Agric. Research Service, Brownsville, TX). J. Econ. Entomol.; 67: No. 3, 463-464 (Jun 1974).

A technique is described for making quantitative sperm counts of tobacco budworms, Heliothis virescens. Male pupae and adults were treated with ^{60}Co radiation and paired with untreated females. Results showed that irradiation of pupae drastically affected the sperm transfer ability of males. The sperm complement was significantly reduced from that of control males. (HLW)

15974 IMMEDIATE BEHAVIORAL RESPONSES OF AN ECHINODERM TO IONIZING RADIATIONS. Dedrick, M. C.; Kimeldorf, D. J. (Oregon State Univ., Corvallis). Physiol. Behav.; 12: No. 3, 393-398(Mar 1974).

The Sea urchin, Strongylocentrotus purpuratus, responded to x-ray exposure by a sudden retraction of tubefeet followed by flexion of spines. At exposure rates of 1.0 to 15 R/s, mean reaction times ranged from 2 to 14 sec for tubefoot retraction while spine flexion occurred in 94 to 180 seconds. In both situations, reaction times varied inversely with exposure rate. A quantal response analysis yielded an ED-50% value of 3.6 R for tubefoot retraction and 12 R for spinal flexion. Limiting exposure to only part of the surface was sufficient to elicit reactions in the exposed and non-exposed areas. Based on reaction time analysis and nerve transection experiments, the subdermal nerve net and the radial nerves are involved in reactions in the shielded area. The reaction time for spinal flexion but not for tubefoot retraction was affected by the presence of light. It is suggested that photoreceptors may act as a site for detection of x-rays by the urchin. (auth)

15975 NATURE AND SENSITIVITY OF BREAKSITES IN A LONG DUPLICATION IN THE X-CHROMOSOME OF DROSOPHILA MELANOGASTER. Subbarao, S. K. Urbana, IL; University of Illinois (1973). 84p. University Microfilms Order No. 74-5712.

Thesis (Ph.D.).

The nature and sensitivity of breaksites in a long duplication of the X-chromosome of Drosophila melanogaster following x-irradiation were investigated. The duplication, TpDp(1;1) MMNB-8, a modified form of the duplication, Dp(1;1)MNB-8, was employed in these experiments. In Dp(1;1)MNB-8, the 16A through 17E subdivisions of the salivary X-chromosome are duplicated. Males bearing the duplication, Dp(1;1)MNB-8, occasionally give rise to one or more of the three types of exceptional offspring which result from spontaneous loss of different portions of the duplication. Cytological analysis of these exceptional offspring indicated that the breaksites were distributed nonrandomly within the duplication and some of the breaksites were observed to exhibit ectopic pairing. On the basis of these observations it was proposed that the breaksites may be heterochromatic in nature. This hypothesis was tested in experiments employing x-irradiation. Males from the stable strain, that is, those which do not yield exceptional offspring spontaneously, and which carry TpDp(1;1)MMNB-8, were employed in these experiments. In this duplication a segment including subdivision 16A and subdivisions 17A through 17E are duplicated and transposed between bands 12F1-2 and 4-5 of the X-chromosome. Males bearing this duplication are genetically (B os$^+$) f (B$^+$ os) car$^+$ and exhibit B os$^+$ phenotype. Males were x-irradiated and mated with homozygous y f B$^+$ os car virgin females, and the female progeny were searched for exceptional offspring which, in turn, were analyzed both genetically and cytologically. An analysis of exceptions obtained following x-irradiation of males of stable strains indicated that the breaksites correspond to those which occurred spontaneously in related unstable strains. This finding supports the hypothesis that "hotspots" are heterochromatic in nature. (Diss. Abstr. Int., B)

15976 MACROMOLECULAR SYNTHESIS AND CELL DIVISION IN X-IRRADIATED TETRAHYMENA. Paul, I. J. Toronto; Univ. of Toronto (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The effects of x radiation on cell division and macromolecular synthesis in heat-synchronized Tetrahymena pyriformis were studied. The sensitivity of synchronized Tetrahymena to x radiation was dependent on the magnitude of the radiation dose and the age of the cell population. Division delays of increasing duration were exhibited by cells irradiated with progressively greater doses of x radiation at a specific time during the cell cycle. Moreover, division delays of increasing duration were produced when cells were irradiated with a specific dose at progressively later times during the cell cycle. The precise time of transition from radiation sensitivity to radiation insensitivity was found to be dose-dependent. The effects of x-radiation on macromolecular synthesis are discussed in relation to the radiation-induced division delay of heat-synchronized Tetrahymena. (Diss. Abstr. Int., B)

15977 RESISTANCE OF WHEAT-NEMATODE LARVAE TO SHORT-WAVE ULTRAVIOLET RADIATION AT LOW AND SUPER-LOW TEMPERATURES. Lozina-Lozinskii, L. K.; Namatov, T. N. (Inst. of Cytology, Leningrad). Sov. J. Ecol. (Engl. Transl.); 3: No. 2, 95-102(1972).

Translated from Ekologiya; 3: No. 2, 5-14(1972).

The reactions of larvae of the nematode (Anguina tritici) to short-wave ultraviolet (uv) radiation during chilling and freezing were studied. The resistance (survival rate) of larvae irradiated with different uv doses at temperatures of +20, –30, –78, and –196°C was determined as a function of incubation time in water after reactivation of larvae of the same age from the resting state (anabiosis). The data obtained were analyzed in the light of cryobiological and photobiological investigations at the molecular and cellular level. The characteristics of the reaction of living systems to external factors at ultra-low temperatures, when the cell and the body are in an anabiotic state, are discussed. (auth)

15978 INTRODUCTORY STUDIES ON THE USE OF RADIATION IN THE CONTROL OF BLACK FLIES (DIPTERA: SIMULIIDAE). Gross, H. P. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Baldwin, W. F.; West, A. S. Can. Entomol.; 104: No. 8, 1217-1222(Aug 1972).

Preliminary investigations of effects of radiation on black flies were undertaken to develop methods of control based on the sterile-male technique. Mature black fly larvae were irradiated at various exposures (from 2 kR to 32 kR) and allowed to complete development in aerated stream water in the laboratory. The larvae were preponderantly Simulium venustum Say, determined by inspection of pupae and adults. It was found that percentage pupation following irradiation remained at a fairly constant level (about 93%), whereas emergence from pupae fell from 54% at 2 kR to 0% at 28 kR. Though variable, the percentage emergence of the controls averaged 47%. Adults inspected for radiation damage appeared unchanged at the lower doses, e.g. 2 kR to 6 kR, compared with controls. At higher doses (e.g. 16 kR) the abdominal cavities usually showed a notable decrease in stored fat bodies. The anterior two-thirds of the abdomens were largely devoid of internal organs, many of which, including the ovaries and testes, were found in a degenerate condition at the posterior tip. (auth)

15979 GAMMA RADIATION SENSITIVITY OF THE SPIDER BEETLE, GIBBIUM PSYLLOIDES (COLEOPTERA: PTINIDAE). Brower, J. H.; Scott, H. C. (Dept. of Agriculture, Savannah). Can. Entomol.; 104: No. 10, 1551-1556(Oct 1972).

The effects of γ radiation at doses from 5 to 100 krad on all metamorphic stages of the spider beetle, Gibbium psylloides (Czenpinski), were studied. Five kilorads prevented development of adults from treated eggs and larvae. Some adults emerged from the pupal cocoon at all treatment levels except 50 and 100 krad, but their longevity was greatly reduced. Adults were fairly resistant to sterilizing effects of the radiation. Twenty kilokrads was not completely sterilizing to either males or females, but fecundity was greatly reduced. The longevity of treated adults was significantly reduced, but some survived for 20 weeks after a 20-krad exposure. Adults and pupae of this species were more radiation resistant than were most other Coleoptera. (auth)

15980 DIFFERENCE IN RADIOSENSITIVITY OF TWO COLONIES OF TOBACCO BUDWORMS, HELIOTHIS VIRESCENS (LEPIDOPTERA: NOCTUIDAE). Proshold, F. I.; Bartell, J. A. (Dept. of Agriculture, Fargo, ND). Can. Entomol.; 104: No. 7, 994-1002(Jul 1972).

Sterility induced by γ irradiation of the adult male tobacco budworm, Heliothis virescens (F.), was studied in two colonies, one was reared in the laboratory for more than 60 generations (laboratory strain) and the other reared for fewer than 9 generations (wild strain). When irradiated males were crossed with untreated females, the percentage egg hatch for each dose was lower with the laboratory than with the wild strain. When laboratory and wild females were crossed reciprocally with irradiated males, the fertilities were similar to those of the laboratory and wild strains, respectively. When irradiated males were crossed with female progeny from reciprocal crosses, the percentage egg hatch was similar to that of the wild strain. Wild strain females were nearly monogamous for the first several generations, but F_9 females mated nearly as frequently as females of the laboratory strain. (auth)

15981 IRRADIATION OF SPERM AND OOCYTES IN ONCOPELTUS FASCIATUS (HEMIPTERA: LYGAEIDAE): SEX RATIO, FERTILITY, AND CHROMOSOME ABERRATIONS IN THE F_1 PROGENY. LaChance, L. E.; Richard, R. D. (Dept. of Agriculture, Fargo, ND). Can. J. Genet. Cytol.; 15: No. 4, 713-721(Dec 1973).

Adult Oncopeltus fasciatus were irradiated as 7- to 8-day-old males, and as 3- to 4- or 10- to 12-day-old females with doses of 8 and 20 krad of γ irradiation and 200 R of x rays, respectively. Treated bugs were outcrossed to untreated bugs, and F_1 progeny derived from irradiated sperm and from prophase and metaphase oocytes were studied. All treated bugs were less fertile than the controls, but none of the treatments produced full sterility. Among the F_1 generation from the three types of crosses, there was no significant deviation from a 50:50 sex ratio. When F_1 males were outcrossed to untreated females, only the males derived from irradiated sperm were semisterile; F_1 males derived from the treated oocytes were as fertile as the controls. The semisterility of the F_1 males was correlated with chromosome translocations and fragments in the spermatocytes. The virtual absence of these aberrations in the testes of F_1 males derived from irradiated oocytes suggests that these aberrations are not induced in oocytes, are repaired, or are not included in the maternal pronucleus after irradiation of meiotic oocytes. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 15370, 15443, 15444, 15461, and 16020.

15982 (CRSSA-1972, pp 89-91) RELATIVE AMOUNT OF EXTERNAL IRRADIATION AND INTERNAL CONTAMINATION EXPERIENCED BY INDIVIDUALS EXPOSED TO RADIOACTIVE FALLOUT. Prat, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Investigations were carried out in order to tentatively establish the immediate radiation risks associated with radioactive fallout. Such risks are a function of time. An attempt was made to evaluate the effects of both external and internal irradiation. The most immediate risks concern the external irradiation of the entire organisms and the skin. The degree of risk encountered depends on the initial level of radioactive fallout in the air, and in particular, on the dose rate near to the ground. Internal contamination risks resulting from ingestion are less immediate. The risks depend on the concentration of radioactive fallout found in drinking water; the concentrations can be related to the dose rate observed at the end of the fallout period expressed as a function of local parameters. In order to reduce the risk of ^{131}I internally contaminating the thyroid (organ having a very important function in the metabolism), the administration of iodine is proposed. Doses of iodine can be administered up to 6 hr after inhalation and offer important advantages. (FR)

15983 (TID-26600, pp vp, Paper 61) WHOLE-BODY COUNTING WITHOUT MASSIVE SHIELDING: CALIBRATION. Preliminary Report. Rahola, T.; Tillander, M. May 1974.

In radioactive foodchains in the subarctic environment.

The calibration of the completely mobile, unshielded whole-body counting system, used for measurements of ^{137}Cs activities in man, was continued and 83 persons were counted. Of these, 52 had also been counted in 1973. Calibration methods are described. The ^{137}Cs whole-body activities obtained in the truck-installed shadow-shielded counting system during 1974 and 1973 are compared. (CH)

15984 ^{239}Pu VS ^{226}Ra TOXICITY IN HUMAN BONE. Harley, N. H.; Pasternack, B. S. (New York Univ., NY). Trans. Amer. Nucl. Soc.; 18: 386(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15985 TABULATION OF DOSE EQUIVALENT PER MICROCURIE-DAY FOR SOURCE AND TARGET ORGANS OF AN ADULT

FOR VARIOUS RADIONUCLIDES. Snyder, W. S.; Ford, M. R.; Poston, J. W. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 387-388(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15986 RADIOBIOLOGIST'S VIEW OF LIGHT-WATER REACTOR EFFLUENTS. Goldman, M.; Book, S. A. (Univ. of California, Davis). Trans. Amer. Nucl. Soc.; 18: 391-392 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

15987 RADON DAUGHTER EXPOSURE AND RESPIRATORY CANCER QUANTITATIVE AND TEMPORAL ASPECTS. Lundin, F. E. Jr.; Wagoner, J. K.; Archer, V. E. NIOSH-NIEHS Joint Monograph No. 1. Washington, DC; Department of Health, Education, and Welfare (1971). 193p. NTIS.

Results are presented from an epidemiological survey on the health status of uranium miners in the USA during 1971. The relation of internal irradiation following chronic inhalation of ^{222}Rn and daughter products to mortality and number of lung cancers in miners is discussed. Standards for permissible annual working levels of radioactivity in uranium mines are presented. The contribution of cigarette smoking and other environmental factors to the health of miners is discussed. (200 references) (CH)

Animals

Refer also to abstracts 15912, 15942, 15961, 16046, and 16048.

15988 (CRSSA-1972, pp 63-64) INVESTIGATION LEVELS IN INTERNAL CONTAMINATION BY THE INHALING OF γ EMITTERS. Relation Between Body Burdens and Doses Resulting from the Inhaling of Fission Product Mixtures. Prat, G. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

An attempt was made to establish numerical values for the body burdens resulting from the accidental inhalation of fission products. Such burdens are calculated using relations between body burdens and the resulting doses in critical organs. Complementary examinations are carried out when doses equivalent to certain fractions of the maximum permissible dose are exceeded. These doses are designated, fundamental levels of investigation, and correspond to body burdens designated, derived investigation levels. The concept of an internal contamination investigation level is useful in both human γ spectrometry and the radiological monitoring of personnel exposed to the risk of inhaling fission product mixtures. The values proposed for the derived fundamental levels are compatible with the accuracy obtained in external irradiation dosimetry, but vary with the delay between the moment of contamination and the measurements, and the delay between the fission event and the moment of contamination. Only measurements made very rapidly after contamination can be interpreted because of the temporal decay in the value of these levels. The significance of these values diminishes in the long term as a result of individual fluctuations in the normal activity of the body, and as a result of a drop in the value of the ratio between levels calculated at this activity. (FR)

15989 (LA-UR-74-968) LUNG IRRADIATION WITH STATIC PLUTONIUM MICROSPHERES. Anderson, E. C.; Holland, L. M.; Prine, J. R.; Richmond, C. R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 29p. (CONF-740648-1). Dep. NTIS $4.50.

From symposium on experimental respiratory carcinogenesis and bioassays; Seattle, Washington, USA (23 Jun 1974).

Ceramic microspheres containing $^{238}PuO_2$ or $^{239}PuO_2$ of respirable size and activity simulating that of respirable particles were injected into the jugular vein of hamsters to produce lung burdens in the range of 0.1 to 1000 nCi. The radionuclide excretion patterns and tissue distribution was followed during 500 days post-injection, and animals that died were examined histologically. Of the initially deposited α activity 90 to 95% was present in the lungs 500 days post-injection and no significant activity was present in other tissues. Only two lung tumors were observed in a total of 1142 animals injected. It was concluded that locally concentrated α irradiation is less damaging in hamster lung than the same amount of energy delivered over larger tissue volumes. (CH)

15990 (RLO-2227-T-8-5) RADIOECOLOGICAL STUDIES OF AMPHIBIANS. Annual Progress Report, June 16, 1973-June 15, 1974. Willis, D. L. (Oregon State Univ., Corvallis (USA). Dept. of General Science). 1974. Contract AT(45-1)-2227. 27p. Dep. NTIS $4.50.

Progress is reported on studies of the radioecological role of amphibians in the freshwater environment. Data are reported from studies on the metabolism of ^{59}Fe in the rough-skinned newt (Taricha granulosa) at 10° and 23°C following a single intraperitoneal injection, in which the distribution in 12 organs and tissues was followed for 100 days; the metabolism of ^{65}Zn in the frog (Rana pipiens) following intraperitoneal injection in which it was demonstrated that ^{65}Zn was retained in melanin pigments and melanophores concentrated in the skin; the effects of external γ irradiation from chronic immersion in $^{134}CsCl_2$ solutions on the western spotted frog (Rana pretiosa) and the Pacific treefrog (Hyla regilla), in which the development of fertilized eggs and tadpoles and survival were used as the test criteria. (CH)

15991 (UCD-472-120) ANNUAL REPORT, FISCAL YEAR 1973. (California Univ., Davis (USA). Radiobiology Lab.). Jun 1973. Contract AT(04-3)-472. 179p. Dep. NTIS $6.25.

Separate abstracts were prepared for 30 sections of this report. A list is included of 50 publications during the period covered by this report that discuss results of studies completed. (CH)

For abstracts of individual sections see: 15371, 15560, 15936-15943, 15992-16002, 16041-16045, 16069, 16070, 17455, and 17456.

15992 (UCD-472-120, pp 57-61) MORBIDITY AND MORTALITY IN ^{90}Sr AND ^{226}Ra TREATED BEAGLES. Chrisp, C. E.; McClatchy, C. H.; White, R. G.; Waterman, D. D.; Wilson, F. D. Jun 1973.

In annual report, fiscal year 1973.

The variety of both medical and surgical conditions in Beagles administered ^{90}Sr and ^{226}Ra over long periods of time increased, as did also the variety of tumors seen. A dramatic increase in the number of heart murmurs over previous years probably reflected both better surveillance and an aging colony. The incidence of mammary tumors remained approximately the same as the previous year, when there were 41, twice as many as in previous years. There were 20 deaths in the ^{90}Sr colony and 15 among the ^{226}Ra dogs. Osteosarcomas, myeloproliferative disease, radiation osteodystrophy, squamous cell carcinomas of the gingiva, and tonsillar carcinomas observed were probably radiation-induced. (CH)

15993 (UCD-472-120, pp 62-65) RADIOGRAPHIC CHANGES IN SKELETONS OF BEAGLES ADMINISTERED ^{90}Sr AND ^{226}Ra. Williams, R. J. R.; Hanson, R. J. Jun 1973.

In annual report, fiscal year 1973.

Radiographic injury scores are compared by dose and time in ^{226}Ra- and ^{90}Sr-treated Beagles. Tumors occurred with increasing frequency in medium dose levels, except in the ^{90}Sr injection group. (auth)

15994 (UCD-472-120, pp 66-69) SCANNING ELECTRON MICROSCOPY OF CANCEROUS BONE OF ^{90}Sr AND ^{226}Ra TREATED DOGS. Pool, R. R.; Crisan, B. Jun 1973.

In annual report, fiscal year 1973.

Similar characteristic resorption lacunae were found at the tumor-bone interface in three bone tumors in ^{90}Sr and ^{226}Ra treated Beagles, indicating that osteoclasia plays a major role in bone resorption in lytic tumors of canine bone. In reactive bone but not in osteosarcomatous bone, cells were entrapped within lacunae. Limited attempts at bone repair were seen in carcinomatous bone examined by scanning electron microscopy and radiography. (CH)

15995 (UCD-472-120, pp 78-83) AVERAGE WHOLE-BODY SKELETAL DOSE RATE AND CUMULATIVE DOSE OF BEAGLES FROM $^{90}Sr-^{90}Y$ BODY BURDEN. Moment, M. H.; Goldman, M.; Wolf, H. G.; Rosenblatt, L. S.; Bustad, L. K.; Pieterzak, V. T.; Wittmier, J. R.; Jow, N. Jun 1973.

In annual report, fiscal year 1973.

Average dose rate and time-integrated dose to 452 Beagles resulting from daily ingestion of $^{90}Sr-^{90}Y$ from in utero to 540 days of age was calculated. Average body burdens were calculated from a series of polynomials of best fit to 25-day increments incorporating each data point. The radionuclide concentration was calculated from skeletal-to-body-weight ratios and individual weights. The body burden at 540 days of age was proportional to the daily intake in all but D60-level dogs in which it was lower. The growth pattern, analyzed by sex, did not show a difference in weight gain to 500 days of age between labeled and control animals. Females had a lower dose rate and time-integrated dose than males at all ages after 100 days. (auth)

15996 (UCD-472-120, pp 84-89) BONE AND BONE MARROW DOSIMETRY OF $^{90}Sr-^{90}Y$ LABELED HUMERI BY A GEOMETRY-DISTRIBUTION FACTOR: DETERMINATION OF TEMPORAL AND SPATIAL DISTRIBUTION IN BEAGLES. Moment, M. H.; Jow, N.; Worden, L. L.; Countis, T. M. Jun 1973.

In annual report, fiscal year 1973.

Evaluation of possible effects from $^{90}Sr-^{90}Y$ deposited in the

skeleton requires an accurate assessment of spatial and temporal microdose distribution. A function $G(t) = g_1 g_2(t)$ as a measure of local geometry, g_1, and microdistribution of ^{90}Sr-^{90}Y, $g_2(t)$, in the humeri of dogs that had previously been fed ^{90}Sr throughout early life was determined utilizing a combination of thermoluminescent dosimetry and measurement of local deposits of radioactivity. Radioactivity distribution was measured in 24 cross sections and compared with autoradiographic and microscanning measurements. The geometric-microdistribution function, G(t), and relative bone mineral (^{90}Sr) turnover indicated dose distributions in the range of about 5 to 10% in the most cancellous regions to approximately 50 to 60% in the more cortical regions relative to D_{av}. The dose rate and time-integrated cumulative dose to bone and bone marrow were calculated based on G(t). (auth)

15997 (UCD-472-120, pp 90-95) CALCULATION OF DOSE RATE AND TIME-INTEGRATED DOSE OF INGESTED ^{90}Sr IN BEAGLES BY LOGISTIC AND EXPONENTIAL FUNCTIONS. Momeni, M. H.; Goldman, M.; Rosenblatt, L. S.; Wittmier, J. R.; Pietrzak, V. T.; Jow, N. Jun 1973.

In annual report, fiscal year 1973.

Dose rate and time-integrated dose from ingested ^{90}Sr to 64 Beagles at the D30, D40, and D50 levels were calculated using a logistic and a two-exponential function for body burden accretion and retention, respectively. Body burden concentration was adjusted for skeletal ossification before 250 days of age, utilizing dry-to-wet skeletal ratio. Effective half-retention periods were about 0.43 and 10.7 yr for the fast and slow turnover pools. No significant difference in the values of half-retention periods among D30, D40, and D50 was observed. (auth)

15998 (UCD-472-120, pp 96-104) CHANGES IN ^{226}Ra AND $^{90}Sr/^{90}Y$ LABELED HUMERI AND AN ESTIMATE OF TOTAL BODY ^{226}Ra BURDEN OF DOGS: A PRELIMINARY REPORT. Momeni, M. H.; Williams, R. J. R.; Fisher, G. L. Jun 1973.

In annual report, fiscal year 1973.

Relative bone changes of ^{226}Ra- or $^{90}Sr/^{90}Y$-labeled humeri of Beagles were measured by radiographic and ^{125}I density measurement for correlation of the dose-effect relationship. Bone damage is reported by an index of injury from 0 (normal) to 6 (bone tumor). Mean index of injury levels increased with dose. Based on a humeri to body burden ratio of 0.07 the total body burden for each animal was estimated and compared with the calculated values from Rn/Ra ratios. (auth)

15999 (UCD-472-120, pp 109-112) QUANTITATIVE AUTORADIOGRAPHIC DOSIMETRY OF ^{226}Ra LABELED HUMERI OF BEAGLES. Momeni, M. H.; Rosenblatt, L. S.; Soo, S.; Coffelt, S. Jun 1973.

In annual report, fiscal year 1973.

The humerus of an ^{226}Ra-labeled Beagle was crosssectioned into 6 regions, each cut into sections about 100 μm thick for α-track counting autoradiography. A nonuniformity in α-track distribution to as high as 78% of the mean was measured. The average dose rate to the soft tissue and bone was calculated. The radium concentration at midshaft was lower than at proximal and distal bones. The maximum concentration at the proximal head (10.4 nCi/g of bone) gave 8.1 rad/day and the least concentrated region (4.8 nCi/g of bone) gave 3.7 rads/day to the bone soft tissue. (auth)

16000 (UCD-472-120, pp 119-122) ELECTROPHORETICALLY FAST MIGRATING SERUM ALBUMIN ASSOCIATED WITH CANINE ^{90}Sr-INDUCED MYELOGENOUS LEUKEMIA. Shifrine, M.; Wilson, F. D.; Chrisp, C. E.; Neves, J. W. Jun 1973.

In annual report, fiscal year 1973.

Sera obtained from 3 cases of spontaneous and 4 cases of transplanted ^{90}Sr-induced canine myelogenous leukemia exhibited abnormally high electrophoretic mobility of albumin in acrylamide and agar gels. Sera from 100 normal dogs or from 100 patients with various non-neoplastic diseases in the UC Veterinary Medical Teaching Hospital exhibited a normal migrating albumin. The potential use of fast-albumin as a clinical test for detection of the leukemic state is suggested. (auth)

16001 (UCD-472-120, pp 130-133) SERUM COLONY-STIMULATING ACTIVITY OF CHRONICALLY IRRADIATED BEAGLES: PRELIMINARY RESULTS. Wilson, F. D.; McNeill, C. J.; Munn, S. L.; Rosenblatt, L. S. Jun 1973.

In annual report, fiscal year 1973.

Preliminary assays for colony-stimulating ability of bone marrow cells in sera suggest that chronic irradiation (particularly α-irradiation) decreases the ability of sera to stimulate hematopoietic colony formation. Such findings contrast to those of other investigators in acute radiation studies. Sera from ^{226}Ra dogs were also characterized by an apparent loss of an inverse relationship of CSA to blood neutrophil levels that was evident in both ^{90}Sr (D50 level) and control dogs. It is likely that, in addition to direct effects on hematopoietic cells, α-particles might influence an endosteal, relatively radioresistant stromal cell population. (auth)

16002 (UCD-472-120, pp 134-136) BONE MARROW PLAQUE FORMING ASSAY: PRELIMINARY OBSERVATIONS ON EFFECTS OF CHRONIC IRRADIATION WITH ^{90}Sr AND ^{226}Ra. Wilson, F. D.; McNeill, C. J.; Munn, S. L.; Rosenblatt, L. S. Jun 1973.

In annual report, fiscal year 1973.

Surface-related fibroblastic plaque formation occurred in association with methylcellulose-supported hematopoietic cell culture systems. Plaque formation was quantitated and sera obtained from different dogs had differing plaque stimulating activity (PSA). Preliminary results suggest that PSA is inversely related to blood neutrophil levels and that chronic irradiation with ^{90}Sr appears to affect serum levels of PSA more than does ^{226}Ra. The plaque assay may measure a previously undescribed hematopoietic regulator; the possibility of such materials having bone marrow stromal elements as target cells is postulated. (auth)

16003 EFFECTS OF PLUTONIUM IN ANIMALS. Thompson, R. C. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 389(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16004 ABSORBED DOSE PATTERNS IN THE BEAGLE THORAX AFTER INHALATION OF ^{90}Sr–^{90}Y FUSED CLAY PARTICLES. Snipes, M. B.; Hulbert, A. J. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Trans. Amer. Nucl. Soc.; 18: 390-391(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16005 INTERNAL DOSIMETRY IN SMALL VERTEBRATES RESIDENT IN A FALLOUT FIELD. Mullen, R. K. (Mission Research Corp., Santa Barbara, CA); Medica, P. A. Trans. Amer. Nucl. Soc.; 18: 391(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16006 EFFECT OF ^{131}I RADIATION ON THE RAT THYROID. Role of the Hypersecretion of Endogenous TSH. Berthezene, F. (Hopital de l'Antiquaille, Lyon). Ann. Endocrinol. (Paris); 34: No. 5, 578-587(Sep 1973). (In French).

Injection of 10 to 40 μCi ^{131}I produced three months later: a parallel decrease in thyroid's weight and radioiodide uptake, an increase in plasma TSH, a resistance of thyroglobulin to proteolysis, an increase in thyroid labelled I- and T_3/T_4 ratio, and no change in MIT/DIT ratio or in the amount of iodothyronines. The iodoprotein consisted of thyroglobulin identical to that of normal rats. Massive doses of TSH gave a similar increase in resistance of thyroglobulin to digestion. Physiological doses of T_4 impaired the radiation-induced changes in thyroid iodine metabolism. So most and maybe all of them appear to be due to the hypersecretion of endogenous TSH. (FR)

16007 HISTOCHEMICAL PHOSPHATASES AND METACHROMASIA IN MURINE TUMOURS INDUCED BY BONE-SEEKING RADIONUCLIDES. Bland, M. R.; Loutit, J. F.; Sansom, J. M. (Medical Research Council, Harwell, Eng.). Brit. J. Cancer; 29: No. 3, 206-222(Mar 1974).

Tumors induced in mice, either CBA normal and chimaerical, or C3H, by ^{90}Sr or ^{226}Ra or plutonium have been examined histochemically with (1) diazotate fast red violet LB salt in naphthol AS-MX phosphate buffer at pH 8.6 and 5.2, (2) 1:9 dimethyl methylene blue (Taylor). The diagnosis of osteosarcoma is facilitated with Taylor's Blue, which stains osteoid metachromatically. Cells of osteosarcoma, like normal osteoblasts, contain alkaline phosphatase but this may be lost by mutation either in the original tumor or subsequently on passage of the tumor serially to compatible hosts. Osteosarcomata may contain giant-cells of two forms, bizarre tumor cells and osteoclasts; the latter contain acid phosphatase. Osteosarcomata, which retain their osteoid on serial passage, have few cells containing acid phosphatases. Primitive mesenchymal cell tumors of angiomatous form may occur, if the bone marrow is irradiated e.g., by ^{90}Sr–^{90}Y and Pu. These tumors lack osteoid and cells interpretable as osteoblasts or osteoclasts (though they destroy bone). Tumors classifiable as fibrosarcomata occur rarely, and may be truly of fibroblastic origin or be mutated osteosarcomata. Lymphomata also occur when the marrow is irradiated (^{90}Sr–^{90}Y and Pu). They may be generalized, when their cells may contain alkaline phosphatase or lack it. They may be localized to abdominal viscera, the reticulo-sarcomatous form, in which case the cells lack alkaline phosphatase. (auth)

16008 TRANSPLANTATION OF RADIATION-INDUCED CANINE MYELOMONOCYTIC LEUKEMIA. Shifrine, M.; Wolf, H. G.;

Taylor, N. J.; Galligan, S. J.; Wilson, F. D.; Colgrove, G. S.; Bustad, L. K. (Univ. of California, Davis). Bibl. Haematol.; No. 39, 158-169(1973).

Strontium-90-induced myelomonocytic leukemia was transplanted five times in beagle dogs via intrauterine fetal inoculation of malignant cells. The gross pathology of donor and recipient dogs is detailed. An outstanding feature in the recipients was the presence of solid chloromatous tumors. Cytogenetic evaluation of various tissues from all recipient dogs showed proliferation of donor cells. The derived cell line was pseudodiploid (2n = 78) and contained a very small unpaired acrocentric autosome, which is considered a marker for the malignant cell line. (auth)

16009 EFFECT OF RADIOACTIVE CONTAMINATION ON MEADOW SOIL MICROFAUNA. Krivolutskii, D. A.; Kozhevnikova, T. L. (Inst. of Plant and Animal Ecology, Moscow). Sov. J. Ecol. (Engl. Transl.); 3: No. 2, 148-151(1972).

Translated from Ekologiya; 3: No. 2, 69-74(1972).

The distribution of radionuclides in the soil and vegetation was investigated in areas of 10 m^2 of meadow soil experimentally contaminated with the radionuclides ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{106}Ru, and ^{95}Zr. A reduction in the number, distribution, and species range of the micro-arthropods was observed. In nonisolated areas, the effect of radioactive contamination was accurately observed for the whole soil profile. The surface dwellers were the least diagnostic, evidently because of their vigorous horizontal migration. The adverse effect of contamination was most strongly shown in groups having high rates of reproduction and replenishment of the population. (auth)

16010 EXPERIMENTAL EVIDENCE OF DIFFERENT BIOLOGICAL EFFECTS OF ^{125}I AND ^{131}I. Lewitus, Z. (Beilinson Hospital, Petach Tikva, Israel). pp 433-439 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

There are no practical means for dosimetric measurements of the energy deposition in submicroscopic units of a cell. Until now it has been possible only to compute it by comparison and/or extrapolation from accepted LET values. In order to compare the RBE of ^{125}I and ^{131}I by biological means, Wistar rats in groups of 10 were injected with identical amounts of the two isotopes in doses varying from 10 to 120 μCi. Various parameters of thyroid function, e.g., the weight of the gland, radioiodine uptake, PBI-131-conversion ratio, and responsiveness to a goitrogen, were determined and electron microscopy was utilized after intervals of time ranging from eight to 100 days. The first signs of injury, manifested as a decrease in radioiodine uptake seen after eight days, was found to be elicited by smaller amounts of ^{125}I than of ^{131}I. However, the turnover of iodoproteins was higher in the animals treated with ^{125}I than in both those treated with ^{131}I and the controls. From the 8th day, there was also an increase in the weight of the glands which reached a peak at about 90 days and then decreased to the pretreatment levels. The rats treated with ^{125}I plus a goitrogen responded with a hyperplasia of the gland, as did the controls, while those of the ^{131}I groups did not. These results support the view that ^{125}I exhibits a greater biological effect in the thyroid than ^{131}I and specifically damages the potency of normal hormone synthesis. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstract 15386.

Man

Refer also to abstracts 14760, 14850, 14851, 15387, 15388, 15442, 15457, 15868, 15986, 16046, 16089, 16090, and 16125.

16011 (CRSSA-1972, pp 75-79) SENSITIVITY AND ACCURACY OF HUMAN γ ACTIVITY MEASUREMENTS. Poutrain, P.; Prat, G.; Nicolle, D. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The accuracy and sensitivity of two types of human γ spectrometer systems were examined: a portable installation without a counting shield, which enables rapid measurements to be made for groups of individuals (such examinations may be of short duration when relatively high thresholds are accepted with low accuracy levels); an installation incorporating a shielded enclosure for evaluating different radioisotope body burdens. This later system is provided with three detectors and has a counting efficiency that is very geometry dependent (major problem with extended sources such as the whole body). Both theoretical and experimental considerations suggest the use of flat geometries. A gain in efficiency is obtained with such geometries when counting times exceeding 10 min are employed. A flat set-up led to reproducible results (under suitable conditions) and enabled corrections to be introduced for the morphology of the individuals examined. (FR)

16012 (CRSSA-1972, pp 79-80) EXCRETION OF ^{137}Cs, ^{60}Co, ^{144}Ce, ^{90}Sr, AND ^{239}Pu BY MAN. Rocquet, G.; Quentric, Y.; Gueguen, J. P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Determinations were made of ^{137}Cs, ^{60}Co, ^{144}Ce, ^{90}Sr and ^{239}Pu in the urine and stools of individuals voluntarily contaminated by inhaling radioactive dusts, these dusts being of known composition. The daily level of excretion was established for each of the radioisotopes concerned. (FR)

16013 (CRSSA-1972, pp 246-248) AUTOMATIC ACQUISITION OF HUMAN WHOLE-BODY γ SPECTRA AND COMPUTER PRE-PROCESSING. Frossard, H. (Centre de Recherches du Service de Sante des Armees, Clamart, France); Arnaud, G.; Morin, D.; Berche, C.; Gilloreau, A. 1972. (In French).

Automatic data acquisition techniques for human whole-body γ radiation counting applications are described. Information initially obtained on punched tape is transferred onto magnetic tape using classical information processing techniques. The quality control processing procedures were used that involved the setting up of a magnetic indexing system containing all known spectra corrected for errors detected with the program. The results of various examinations together with the corresponding errors were used to publish a list from which corrections could be made. 5000 whole body counting spectra were acquired and processed in this way. The work undertaken also led to examination of both the collective and time development aspects of γ radiation monitoring problems. (FR)

16014 (INIS-mf-987, pp 1.1-1.7) BIOLOGICAL EFFECTS OF RADIATION. Watson, G. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1972.

A brief review of the effects of ionizing radiations on living organisms is presented with specific reference to the hazards of uranium mining. Aspects considered are the nature of radiation injury; short term, delayed somatic and genetic radiation effects; implications for radiation protection; and dose-response relationships. (INIS)

16015 (INIS-mf-987, pp 2.1-2.9) LUNG CANCER IN URANIUM MINERS. Watson, G. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1972.

Uranium miners face four health hazards that include external gamma radiation, nonradioactive dusts, radioactive dusts, and radon gas. The problem of α emitters and its effect on the lung tissue is discussed and a discussion on setting exposure standards is presented. The incidence and the type of lung cancer which occur in U. S. miners is described. (INIS)

16016 (INIS-mf-1133) WEIGHT INDEXES OF HUMAN FETUS DEVELOPMENT AND Sr AND Ca ABUNDANCE IN THE SKELETON. Borisov, B. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow). 1973. 14p. (In Russian). INIS.

The weight relation of bones in the skeleton of the developing fetus and the accumulation in it of the stable elements Sr and Ca, whose exchange is analogous to the exchange of ^{90}Sr, was studied. From the beginning of the fifth month of pregnancy until parturition the weight of the human skeleton increases from 39 to 390 g and comprises 11% of the weight of the body regardless of age. The skeleton of the new-born infant averages 48.8% water, 31.8% organic matter, and 19.4% mineral. The cartilage weight is about 20% of the skeleton in the newborn. The Ca content of the fetal skeleton before birth is not constant but increases with growth. The greatest rate of stable Sr increase in the fetal skeleton is in the last part of pregnancy (9-10th month). The regularity of growth of the skeleton and the absolute Ca and Sr contents may be described by the index functions, with the increase in content of these elements in the bone tissue taken as the increase in the whole skeleton. Expressed in per gram of ash, the distribution of Ca and Sr is the same in different bones. Per gram of dry weight of bone tissue, they are highest in the ribs and lowest in the vertebrae. The average in the skeleton of the newborn is 27.3 ± 5.9 g of Ca and 16.3 ± 5.1 mg of Sr. (tr-auth)

16017 (LA-tr-74-16) PHYSIOPATHOLOGY OF PLUTONIUM CONTAMINATION: FUNDAMENTAL CONCEPTS. Saenz, M. D. L.; Ramos, E. Translated from Energ. Nucl. (Madrid); 17: No. 84, 261-282(1973). 43p. Dep. NTIS $5.25.

Literature on the physical, chemical, and biological processes involved in internal contamination caused by Pu isotopes is re-

viewed. Some topics discussed are physical and chemical aspects of Pu; inhalation of radioactive aerosols; deposit and mobilization of particles in the respiratory tract; absorption of Pu by the gastrointestinal tract; interaction with plasma proteins in the blood; distribution in the skeleton, bone marrow, liver, and other tissues; toxicity; effects on the lung,skeleton, and liver; elimination; and evaluation of internal contamination. (HLW)

16018 (WASH-1251) APPLICATIONS OF BIOASSAY OF URANIUM. Alexander, R. E. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1974. 209p. Dep. NTIS $7.60.

The criteria for a uranium bioassay program are reviewed. It is pointed out that a bioassay program is necessary if air sampling is necessary for purposes of personnel protection. The extent of the bioassay program is determined by the magnitude of air sample results. A work area qualifies for the minimum bioassay program so long as the quarterly average of air sample results is ≤10% of the Derived Air Concentration (DAC) and the maximum used to obtain the average is ≤25% of DAC. It must be demonstrated that air sample results used for this purpose are representative of personnel exposure. Under the minimum program, bioassays are performed semiannually or annually for all workers to monitor the accumulation of uranium in the lung and bone. More frequent bioassays are performed for a sample of the most highly exposed workers as a check on the air sampling program and these bioassays are performed at sufficient frequency to assure that a significant single intake of uranium will be identified before biological elimination of the uranium renders the intake undetectable. If a work area does not qualify for the minimum program, bioassays in addition to the minimum program are performed at increasingly higher frequencies, depending on the magnitude of air sample results. A model is used which correlates bioassay measurement results with radiation dose or with uptake of uranium in the blood (chemical toxicity). Actions are specified, depending upon the dose or uptake indicated by bioassay results. These actions are corrective in nature and are intended to ensure adequate worker protection. Guidance is provided for the difficult task of determining, from individual data rather than models, the quantity of uranium in body organs, the rate of elimination, and the dose commitment. This bioassay program encourages improvement in the confinement of uranium and in air sampling techniques by specifying bioassays only to the extent that confinement and air sampling can not be entirely relied upon for personnel protection. Data are appended on mass limits for uranium in blood, urinary excretion factors, biological models for the tissue distribution and excretion of inhaled uranium, and in vivo measurement capability for mixtures of uranium isotopes. This report does not have the effect of a Regulatory Guide. Official guidance on the subject of bioassay for uranium is given in Regulatory Guide 8.11, Applications of Bioassay for Uranium. (69 references) (CH)

16019 PERSONNEL CONTAMINATION FROM ^{125}I USED IN BIOLOGICAL AND MEDICAL LABORATORIES. Paperiello, C. J.; Gabay, J. J. (New York State Health Dept., Albany). Trans. Amer. Nucl. Soc.; 18: 100(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16020 MEASUREMENT OF RADIUM IN MAN. Rundo, J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 384(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16021 IN-VIVO DETECTION OF TRANSURANIC ELEMENTS IN THE HUMAN LUNG. Dean, P. N. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 384-385(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16022 INTERNAL DOSIMETRY OF FALLOUT RADIONUCLIDES. Bennett, B. G. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 18: 386-387(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16023 EXAMINATION OF THE POTENTIAL RELATIVE TOXICITY OF URANIUM AND PLUTONIUM IN LWR AND HTGR FUEL. Wrenn, M. E. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 392-393(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16024 ERYTHROCYTIC ^{86}Rb UPTAKE ABNORMALITIES IN LEUKEMIA. Chollet, P.; Bard, J. J.; Bidet, J. M.; Plagne, R.; Meyniel, G. (Institut National de la Sante et de la Recherche Medicale, Clermont-Ferrand, France). Biomedicine; 21: No. 1, 30-35(20 Jan 1974). (In French).

The uptake of rubidium-86 by human red blood cells was studied in vitro on leukemic patients with various cytologic types. The uptake rate is significantly reduced in slightly less than half of the patients. This alteration is not correlated with the cytologic type of the disease. On the other hand, rubidium uptake is higher than normal in patients with very high leucocytosis. This seems to be related to the rubidium uptake by white blood cells. The existence of a relationship between these alterations and some abnormalities in blood groups or enzymatic activities reported in leukemias is consequently possible but needs some further comparative investigations. (FR)

16025 TREATMENT AFTER INCORPORATION OF RADIONUCLIDES. Volf, V. (Kernforschungszentrum, Karlsruhe, Ger.). pp 743-760 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

In view of the potentially harmful effects of even small amounts of certain deposited radionuclides, the procedures for removing them from the body are of great importance. Some of the decorporation methods would be useful also in the removal of non-radioactive metals incorporated as a result of industrial or environmental exposure. First air and prompt treatment measures after internal radioactive contamination are discussed from the point of view of their practical applicability. Thus, the effects are reviewed of phosphates, sulfates, and alginates on intestinal absorption and excretion of alkaline earth metals as well as the action of ferrihexacyanoferrate on cesium and thallium. Furthermore, the high effectiveness of chelating agents shortly after incorporation of certain radionuclides as well as the problems of a prolonged chelation therapy are elucidated and some future possibilities are indicated. (auth)

16026 IN VIVO MEASUREMENTS OF URANIUM CONTAMINATION IN THE LUNG. Riklis, E.; Degani, N. (Nuclear Research Centre-Negev, Beersheba, Israel). pp 779-788 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The commonly used method for detection of internal contamination with uranium, as well as of all other radionuclides, is urinalysis. In cases of nontransportable uranium contamination by inhalation, experience has shown that urinalysis gives erratic results which prevent accurate calculation of the inhaled amount. A method for direct in vivo measurement of natural uranium was previously developed based on whole-body counting of the 186 keV line of ^{235}U. The counter is placed directly over the lung area. This procedure requires corrections due to the presence of ^{137}Cs and ^{40}K in the body and the parallel measurement of a double used as a control. A newly developed method gives direct in vivo determination of uranium contamination by counting the soft L x-ray (10 to 20 keV) contribution of ^{238}U and ^{234}U. Counting is done inside the low background whole-body chamber with two proportional detectors (30 × 15 cm) flushed with argon and methane. Quantitative calibration was done with sponges saturated with UO_3 and placed in the chest cavity of a male goat weighing 75 kg. The detection threshold obtained is about 1/3 of the maximum permissible lung burden. Work is in progress to improve the apparatus and procedure. (auth)

16027 DETERMINATION OF ^{137}Cs AND ^{40}K CONTENT IN MAN. Riklis, E.; Degani, N.; Ronen, M.; Romm, E.; Luz, J.; Sobel, A. (Nuclear Research Centre-Negev, Beersheba, Israel). pp 789-794 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

Whole-body counters are used to measure γ-emitting radioisotopes in the human body. Ordinarily two isotopes exist in quantities which show a distinguishable spectrum. These are ^{40}K, a natural radioactive isotope which exists at a concentration of 0.012% of potassium, and ^{137}Cc, which has become part of our natural environment. The problem of electrolyte balance, especially sodium and potassium content, and excretion rates has long been of special interest to us in relation to physical activity and climatic stress conditions. The problem of cesium behavior under such conditions is of interest since it is one of the major radioactive isotopes in the world background to which man is constantly exposed. Results of a study on the influence of stress conditions on the levels of ^{40}K and ^{137}Cs are presented. Compar-

isons of potassium levels are made based on age, sex, and country of origin. (auth)

16028 WHOLE-BODY COUNTING: EIGHT YEARS EXPERIENCE IN THE USE OF THE AEB WHOLE-BODY COUNTER. Selzer, A.; Basson, J. K.; Jansen, C. R. (Atomic Energy Board, Pelindaba, South Africa). pp 795-804 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The South African Atomic Energy Board's whole-body counter has been in use since November 1964 and was erected for a dual purpose, viz., control over the internal contamination of radiation workers employed at the National Nuclear Research Centre, Pelindaba, and for medical/biological studies in cooperation with the AEB Life Sciences Division and other research institutes. A 24 cm × 15.2 cm ϕ NaI(T1) scintillation crystal (with a photomultiplier at each end) is used in conjunction with a multichannel pulse-height analyzer as detection equipment. For counting geometry, the Marinelli Chair was chosen as a compromise between arc geometry, small distance, and personal comfort. A low background is obtained by the use of a steel room of 240 × 210 × 210 cm^3 with 20 cm walls. Several cases of internal contamination with radionuclides were observed over the period of operation, but all were well below the maximum permissible body burden. Radiodiagnostic studies which are done on a routine basis include body-potassium measurements, iron and vitamin B_{12} absorption tests, and excretion studies. The use of a whole-body counter for medical diagnostic tests is, however, limited to those tests where information about the uptake and excretion of substances is of importance. (auth)

16029 COMPARISON OF CALIBRATION TECHNIQUES FOR THE ASSESSMENT OF ^{239}Pu LUNG BURDENS. Clemente, G. F. (CNEN, Casaccia, Italy). pp 805-819 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

In the measurement of subjects contaminated with ^{239}Pu the calibration procedure presents many difficulties by reason of the very low energy of the x rays considered. The attenuation of the ^{239}Pu x rays escaping from the chest shows a strong dependence upon the body size of the subjects. Therefore, a calibration procedure based on a tissue equivalent phantom can give very serious errors in the evaluation of lung burdens "in vivo". The ^{239}Pu counting equipment used consists of a twin crystal composed of a 125 mm × 0.5 mm NaI(T1) crystal optically coupled to a 125 mm × 50 mm CsI(Na) crystal. The two crystals are connected to a Pulse shape discrimination system. In this paper the results obtained by using the following two calibration techniques are compared: the measurement of thin sources of ^{239}Pu localized in different positions inside the lungs of a tissue equivalent phantom; and the measurement of three human volunteers of very different body size, who inhaled an aerosol labelled with ^{103}Pd as a simulator of ^{239}Pu. The results obtained show that the calibration factors obtained on subjects of very different body build will vary by about a factor of ten. As a consequence, if a phantom calibration is employed, a correction factor has to be found which will take into account the variations in the response of the counter due to the different body sizes of the subjects. Furthermore, the variation of the response of the counter has been studied as a function of both the position of the crystal on the subject and the individual body size. The results obtained will be discussed in the paper. (auth)

16030 THORIUM. Suzuki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Shin Kinzoku Kogyo; 18: No. 3, 59-65 (Mar 1973). (In Japanese).

The chemical and radioactive toxicities of thorium were explained and metabolic disturbances of thorium compounds were described. The chemical toxicity of thorium as a heavy metal is low. It is thought to be due to the fact that thorium turns instantaneously an insoluble colloidal state in vivo to enter the reticuloendothelial tissue. The LD_{50} of thorium in animal experiments was tabulated according to the route of administration. As the radioactive toxicity, there are internal exposure to α rays and exposure to γ rays emitted by the daughter nuclides. The decay sequence of thorium was referred to, and the resultant daughter nuclides and their radiation were shown. Although thorium is little absorbed from the digestive tract, once in vivo it is phagocytized by phagocytes and the reticuloepithelial system to remain for long. It is accumulated particularly in the liver and bone marrow. The absorbed thorium is deposited in the lungs for a long time, and although some goes to the bone marrow, the majority is gradually eliminated into the digestive tract. Given as examples of thorium disturbances in the human body were cases of the incidence of hepatic cancer in patients after injection of thorotrast and cases of bone impairment in American factory girls dealing with the luminous paint of radium. When ^{232}Th comes to be used as atomic fuel in large amounts, mixtures of ^{233}Th, ^{229}Th, and ^{230}Th will be handled. The danger of internal exposure due to inhalation would be the sum of the dangers of these nuclides and their daughter nuclides. The energy ratio of radiation in decay of thorium is about $\alpha:\beta:\gamma = 90:9:1$, the majority of thorium disturbances being attributed to α rays. It was described however that when exploitation of atomic power advances, the prevention of disturbances from exposure to γ rays would also be a talking-point. (JA)

16031 IODINE EXCRETION IN 24-HOUR URINE. Halvorsen, A. O.; Muri, R. Tidsskr. Norske Laegforen.; 94: No. 15, 987-990(30 May 1974). (In Norwegian).

The excretion of iodine in 24-hour urine was measured in men in two coastal and two inland areas in Norway in the winter 1971/72. The excretion of μg I/g creatinin in a casual afternoon specimen was examined in the same men in the summer of 1972. The mean excretion ranged from 145 μg I/24 hour at Vågå, to 264 μg I/24 hour at Vadsø, with a grand mean about 200 μg I/24 hour, winter and summer. This difference is not significant at the level of $p = 0.05$. We have not found any significant difference between winter and summer excretions with $p = 0.02$. A 95% confidence limit for the median = 176 μg I/24 hour, is within the range 145 to 201 μg I/24 hour. Iodine ^{127}I -intake at this level compared to the advised minimum of 1 μg I/kg b.w., may reduce the radiation from ^{131}I-exposure to the half. (auth)

16032 DOSE TO THE URINARY BLADDER FROM RADIONUCLIDES IN URINE. Unnikrishnan, M. (Bhabha Atomic Research Center, Bombay). Phys. Med. Biol.; 19: No. 3, 329-340 (May 1974).

The estimation of dose to the walls of the urinary bladder, giving due consideration to its dynamic nature, has been studied from radionuclides in the urine. A general schema for calculating the cumulated dose, for any given filling time and amount of urine collected, is briefly described. A method is developed for determining the maximum dose rates as a function of volume for beta emitters in urine, based on the scaled absorbed dose distribution around point beta sources. The dose rates from monoenergetic photons as a function of the volume of bladder contents are derived from published data. As an illustration of the use of the proposed scheme, the dose received by the bladder from an intravenous administration of ^{131}I-Hippuran has been computed. The cumulated gamma and beta doses are found to be directly proportional to the filling time and to be smooth functions of the final volume of urine. These new dose estimates are compared and contrasted with some reported values based on a static bladder model. The effect of the initial volume of urine present at the time of administration of the activity is also investigated and shown to be significant. (auth)

16033 PLUTONIUM CONTAMINATED WOUND EXPERIENCE AND ASSAY TECHNIQUES AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Johnson, L. J.; Lawrence, J. N. P. (Los Alamos Scientific Lab., NM). Health Phys.; 27: No. 1, 55-59(Jul 1974).

The incidence of puncture wounds potentially contaminated with plutonium over the period since 1960 at the Los Alamos Scientific Laboratory is reviewed. Ten cases with activity deposits greater than 1% of the present 40 nCi maximum permissible body burden value have been experienced. Techniques employed for estimating the level of plutonium activity at the wound site and for determining the depth of deposition of the contaminated debris are discussed. The use of these analytical methods to aid in treatment is described and one case history is reviewed. Data on the anatomical location of 137 injuries potentially involving transuranic materials showed the upper extremities to be the most usual wound site. More than 80% of these cases involved the fingers and hands. (auth)

Animals

Refer also to abstracts 15441, 15445, 15447, 15449, 15459, 15460, 15462, 15912, 15991, 16004, and 16005.

16034 (CRSSA-1972, pp 53-58) DTPA AND MEMBRANE ALVEOLAR-CAPILLARY TRANSPORT MECHANISMS AND THEIR REGULATION. Ducousso, R.; Brazier, J.; Kress, M.; Pasquier, C. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Experiments related to the removal of radioisotopes from lungs were carried out on isolated rabbit lungs, living rabbits, and ar-

tificial membranes in order to study the transfer of DTPA across the alveolar capillary membrane. An attempt was made to trace the transfer of DTPA to the blood and vice versa in order to establish why the administration of DTPA in aerosol form is more efficient than intravenous injections for the treatment of respiratory contamination with elements such as lanthanum. Contrary to the behavior of ionic substances, DTPA does not penetrate into the cells. Experimental investigations demonstrated that the transfer from the lung to the blood or vice versa occurs by simple diffusion and that this transfer takes place more rapidly from the lung to the blood than from the blood to the lung. In addition, the kidney, which ensures a relatively slow elimination of DTPA from the blood, regularizes, as a consequence, the transfer of this substance from the lung into the blood. (FR)

16035 (CRSSA-1972, pp 58-60) RESPIRATORY CONTAMINATION BY Ce AND La. Changes in the Spontaneous Early Transfer as a Function of the Initial Lung Burden. Ducousso, R.; Kress, M.; Pasquier, C. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The early spontaneous transfer of ^{144}Ce and ^{140}La from the lungs of monkeys was studied for initial lung burdens ranging from 10^{-2} to 10 μg. This transfer was measured during the first 4 hr following inhalation. The spontaneous transfer of Ce and La from the deep lung to the blood takes place very quickly; very little transfer occurs after the first hour. The transfer involves only very small quantities of contaminant and diminishes with increasing initial lung burdens. It was observed that, other than for very small lung burdens (10^{-2} μg), the transfer always represents less than 10% of the initial quantity deposited. The transfer behaviors of Ce and La were the same for equal burdens. Assuming that these results can be extrapolated to man, it is then possible to deduce the upper limit of the systemic burden after respiratory contamination by the first lanthanides. (FR)

16036 (CRSSA-1972, pp 61-62) EARLY CAPTURE RATE OF LANTHANUM BY ALVEOLAR MACROPHAGES. Ducousso, R. (Centre de Recherches du Service de Sante des Armees, Clamart, France); Masse, R. 1972. (In French).

The variation of the loss in effectiveness of DTPA with its delay in being administered was investigated for the case of respiratory contaminations with ^{140}La. It is concluded that the loss in effectiveness can be related to the capture of colloidal lanthanum by the macrophages. The rate at which chelatable lanthanum disappears by phagocytosis was measured for rats by separating the cellular fraction of the pulmonary washing liquid after the inhaling of $^{140}LaCl_3$. (FR)

16037 (CRSSA-1972, pp 65-66) EFFECT OF MOVEMENT ON THE TRANSFER OF RADIOCONTAMINATING SUBSTANCES FROM A WOUND. Ducousso, R.; Causse, A. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The contraction of a muscle with a radiocontaminated wound can provoke the transfer of contamination. Experiments were carried out on rabbits in order to investigate this phenomenon. A laceration was made in the flexing muscle of the thigh; the laceration was then contaminated with ^{85}Sr and ^{144}Ce. The muscle was subjected to electrical pulses. The movement caused by the stimulation rendered it possible to measure the activity at the site of the wound. The radioactivity of the blood is the most faithful representation of the transfer taking place. It is this factor that was measured. It was observed that the passage of transferable radioelements into the blood is not significantly modified by movement. It does not therefore appear necessary to immobilize a limb suffering from a radiocontaminated wound in order to minimize the transfer. (FR)

16038 (CRSSA-1972, pp 66-68) COMPARATIVE EFFECTIVENESS OF STRONTIUM INSOLUBILIZING SUBSTANCES FOR THE TREATMENT OF RADIOCONTAMINATED WOUNDS. Ducousso, R.; Causse, A. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

The effectiveness of a radioisotope insolubilizing method for the treatment of wounds contaminated with a strontium salt was investigated. It is concluded that the treatment should be carried out within 10 min of the accident. If a larger delay is involved, a considerable reduction in effectiveness occurs, and after one hour the treatment is useless. Potassium (or sodium) rhodizonate is the most useful insolubilizing substance for this treatment. Saturated magnesium sulfate solutions are also useful and are preferred to calcium alginate and phosphalugel. (FR)

16039 (CRSSA-1972, pp 228-231) USEFULNESS OF ^{57}Co LABELED BLEOMYCINE IN THE DETECTION OF MALIGNANT TUMORS. Experimental Studies with a Tumor Model. Poutrain, P.; Vlaminck, J. P. (Centre de Recherches du Service de Sante des Armees, Clamart, France). 1972. (In French).

Bleomycine (BLM) exhibits anti-tumor properties that appear to be due to delayed mitosis and an alteration in the DNA synthesis. These properties constitute an ideal vector for labeling tumors. An attempt was made to establish the concentration characteristics of BLM in tumoral tissues. The absolute uptake is not very large but the tumor–surrounding tissue ratio is nevertheless sufficient to ensure an excellent contrast: scintigraphic detection (gamma camera) is possible over a relatively long period of time. A mouse cutaneous fibrosarcoma was used in the experiment. The results obtained with ^{57}Co alone and with ^{57}Co labeled BLM are compared. When BLM is used as the vector, the radioactivity uptake of the tumor increases and that of the surrounding tissue decreases. In addition the decay in the radioactivity of the labeled tumor occurs less rapidly and that of the surrounding tissue more rapidly. Thus ^{57}Co labeled BLM is a more efficient labeling substance than ^{57}Co alone. It is also to be noted that the maximum uptake occurs 12 hr after labeling and not 24 hr (as in the case of ^{57}Co alone): 12 hr after the administration of ^{57}Co-BLM, an uptake is observed which exceeds that of ^{57}Co alone by a factor of 4. (FR)

16040 (LF-tr-84) DISTRIBUTION PATTERN OF RADIOCERIUM (^{144}Ce) IN THE WHITE MOUSE. Spode, E.; Gensicke, F. Translated from Naturwissenschaften; 45: No. 5, 117(1958). 4p. Dep. NTIS $4.00.

Mice were injected subcutaneously or intraperitoneally with ^{144}Ce, and the radioactivity of the blood, lungs, liver, spleen, pancreas, kidney, and femur was determined at intervals up to 30 days. A comparison of results following the two types of injection showed considerably higher values for intraperitoneal injection. These results were similar to those obtained in earlier studies on ^{91}Y. (HLW)

16041 (UCD-472-120, pp 1-7) MULTISPECIES APPROACH TO TOXICITY STUDIES. Bustad, L. K. Jun 1973.

In annual report, fiscal year 1973.

The relative benefits of using large animal species (e.g. cats, dogs, primates, swine) vs small ones (e.g. rodents) in radiobiological research are discussed in relation to extrapolations of the conclusions to man. It is concluded that there is no single ideal species for radionuclide toxicity studies. The use of more than one species may be required depending on the test agent, the established endpoints and objectives, and economics. (CH)

16042 (UCD-472-120, pp 73-77) RADIUM-226 AND ^{90}Sr ELIMINATION RATES IN BEAGLES. Parks, N. J.; Abrahams, C. D. Jun 1973.

In annual report, fiscal year 1973.

The urinary and fecal excretion rates of ^{226}Ra and ^{90}Sr were determined radiochemically for six Beagles 1300 to 1400 days post administration. The ^{90}Sr results substantiate previously reported values. The ^{226}Ra biological half-lives obtained by direct radiochemical measurement were found to correlate with those derived from total body burden values computed by a radon retention model which assumes biological independence for eight injections in R40-level dogs. (auth)

16043 (UCD-472-120, pp 105-108) AUTORADIOGRAPHIC MEASUREMENT OF RADIUM-226 DISTRIBUTION IN BEAGLES' LONG BONES: PRELIMINARY REPORT. Momeni, M. H.; Williams, R. J. R.; Coffelt, S. L.; Soo, S. Jun 1973.

In annual report, fiscal year 1973.

Tumor induction at the head and the condyle of the humerus may be due to high uptake of ^{226}Ra at regions of high vascularity. Comparison of radium distribution in humeri of Beagles given 8 injections beginning at 120 or 435 days of age showed a higher uniformity of label in the animal injected at the earlier age. Radium in Beagles injected as young adults appeared on the periosteal surfaces and endosteal surfaces and as intense local activity (hot spots). Structural damage was more pronounced in the animal injected at the earlier age. (auth)

16044 (UCD-472-120, pp 113-114) ORAL DISTRIBUTION OF ^{226}Ra IN ADULT BEAGLES: PRELIMINARY REPORT. Momeni, M. H.; Coffelt, S. L.; Soo, S.; Williams, R. J. R. Jun 1973.

In annual report, fiscal year 1973.

Beagles were given 8 semimonthly intravenous injections of ^{226}Ra starting at 435 days of age, when permanent teeth were in occlusion and the crown and roots were formed. The pattern of radium uptake in teeth and mandibles and the relative activity of different teeth were determined by autoradiographic and microradiographic methods. (auth)

16045 (UCD-472-120, pp 140-143) BEHAVIOR OF ^{131}I IN PREGNANT AND FETAL SHEEP. Book, S. A.; Wolf, H. G.; Ishizaki, G.; Parker, H. R. Jun 1973.

In annual report, fiscal year 1973.

The exchange of iodide between maternal and fetal blood and between fetal blood and amniotic fluid was investigated in pregnant sheep. Iodine-131 was injected into maternal blood, while ^{125}I was injected simultaneously into either fetal blood or amniotic fluid. Regardless of injection site, the radioiodine concentration in the 3 fluid compartments at 48 hr was maternal blood < fetal blood < amniotic fluid. Fetal/maternal ratios of thyroidal radioiodine concentration averaged 4.8 after maternal injection, 6.2 after fetal injection, and 21 after amniotic fluid injection. The high concentration of radioiodine in the amniotic fluid, and the high concentration of fetal thyroidal uptake of ^{125}I from amniotic fluid suggest that the increased uptake of radioiodine by the fetal thyroid gland in late gestation, relative to that of the dam, is related to the unique environment of the developing young. (auth)

16046 ROLE OF THE LYMPH NODES IN INHALATION EXPOSURES. Swinth, K. L. (Battelle Pacific Northwest Labs., Richland, WA); Huth, G. C. Trans. Amer. Nucl. Soc.; 18: 385-386(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16047 IS LIVER A CRITICAL ORGAN IN MAN FOR ISOTOPES OF AMERICIUM? Cohen, N. (NYU Medical Center, Tuxedo, NY); Wrenn, M. E. Trans. Amer. Nucl. Soc.; 18: 386(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16048 INFLUENCE OF AGE ON ^{239}Pu DISTRIBUTION, DOSIMETRY, AND EFFECTS. Sikov, M. R.; Mahlum, D. D. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 389-390(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16049 EFFECT OF TRITIUM OXIDE ON PREIMPLANTATION MOUSE EMBRYOS. Morgan, R. A. Ithaca, NY; Cornell University (1973). 149p. University Microfilms Order No. 74-6331.

Thesis (Ph. D.).

The effects of tritium oxide on development of preimplantation mouse embryos were studied in vivo and in vitro. Embryos were exposed continuously from the two-cell stage to the expanded blastocyst stage to beta radiation from tritium oxide either incorporated into the culture medium (in vitro exposure) or injected into pregnant females (in vivo exposure). For comparison, embryos were also exposed in vivo or in vitro to chronic external gamma radiation from cobalt-60. The radiation dose rates which reduced development to blastocyst to 50% of control values were 115, 230, 100 and 220 rads per day for tritium in vitro, tritium in vivo, cobalt-60 in vitro and cobalt-60 in vivo, respectively. Part of the difference between the in vivo and in vitro sensitivity is attributed to the relative times required for development from two-cell to blastocyst in vivo (45 hours) and in vitro (62 hours) and, therefore, the relative duration of effective radiation. Taking this into account, the total effective LD_{50} values were 298, 433, 259 and 414 rads for tritium in vitro, tritium in vivo, cobalt-60 in vitro and cobalt-60 in vivo, respectively. These results suggest that embryos have a greater sensitivity to chronic irradiation when they develop in vitro rather than in vivo. Analysis of the survival curves indicates that the relative biological effectiveness (RBE) of tritium relative to cobalt-60 is not significantly different from one for this system. In an experiment designed to measure the effects of parentally-administered tritium on preimplantation development, two successive generations of mice were given drinking water containing tritium oxide in concentrations of 0, 10 or 25 μCi/ml. For the first generation of tritium-loaded animals, drinking water containing tritium oxide was given ad libitum to male and female mice starting at four weeks of age. The mice were allowed to mate after drinking tritiated water for six weeks. Second-generation mice at weaning were continued on drinking water containing the same tritium concentration as that given their parents. Male mice of both generations were mated to non-irradiated females. Two-cell embryos were collected, cultured in vitro, and the percentage survival to the blastocyst stage determined. Normalized to control values, approximately 95% and 70% of the embryos sired by males of both generations exposed to 10 and 25 μCi/ml respectively, developed to blastocyst. These results suggest that dominant lethal mutations in paternal germ cells can be expressed by a reduction in percentage survival to the blastocyst stage of two-cell embryos cultured in vitro. (Diss. Abstr.)

16050 ^{45}Ca MOVEMENTS IN GUINEA PIG TAENIA COLI. Uemura, K. (Sapporo Medical Coll.). Sapporo Igaku Zasshi; 42: No. 4, 270-283(Aug 1973). (In Japanese).

The exchange of the intracellular ^{45}Ca in guinea pig taenia coli was analyzed by removing most of the extracellular ^{45}Ca, which obscures the net changes in the ^{45}Ca content of myoplasma. To measure the intracellular ^{45}Ca uptake, La^{3+} was used as follows: after exposure to ^{45}Ca, the strips of taenia coli were washed with a non-radioactive solution of the same chemical composition containing 20 mM $LaCl_3$ for 60 minutes. To measure the ^{45}Ca efflux, the strips of taenia coli were previously exposed to ^{45}Ca and then blotted and washed with a non-radioactive solution for 25 minutes before the experiments. The ^{45}Ca uptake and ^{45}Ca efflux were almost completely blocked by an addition of 10 mM La^{3+}. The Ca fraction obtained by La^{3+} treatment is assumed to be intracellular and largely in a bound state. In normal tris buffered solution, this Ca fraction accounted for 4% of the total tissue Ca and the rate of Ca^{2+} influx was about 0.009 p · mole/cm^2 · sec. The rate of Ca^{2+} influx increased to 0.03 p · mole/cm^2 · sec during 150 mM K^+-induced contracture, but the total Ca content showed no significant change. This cellular Ca fraction increased when the strips of taenia coli were exposed to isotonic 150 mM K^+, hypertonic 40 mM K^+, 10^{-4} M acetylcholine, and low temperature (12°C). The cellular Ca fraction increased when NaCl in the medium was replaced by isotonic sucrose. The increase may reflect a competition between Ca^{2+} and Na^+ for a superficial anionic site in the tissue. Calcium-45 efflux increased during contractions induced by 10^{-4} M acetylcholine of 150 mM KCl. Calcium-45 efflux showed a marked slowing at low temperatures, with a Q_{10} of 1.9 between 12°C and 32°C. This result suggests the existence of an active Ca-extruding mechanism. The extracellular ^{14}C-inulin space showed no change in the presence of La^{3+} or Mn^{2+} and during isometric K-contracture. (auth)

16051 EARLY EXCRETION, RETENTION, AND DISTRIBUTION OF INJECTED CURIUM CITRATE IN BEAGLES. Lloyd, R. D.; Atherton, D. R.; Mays, C. W.; McFarland, S. S.; Williams, J. L. (Utah Univ., Salt Lake City). Health Phys.; 27: No. 1, 61-67(Jul 1974).

The behavior of curium has been studied in five young adult beagles from 0 to 57 days after the intravenous injection of ^{244}Cm + ^{243}Cm in citrate buffer. Total excretion during the first 3 weeks after any injection was mainly urinary. Of the entire Cm eliminated in this 3 week collection period, nearly $^3/_5$ appeared in the first day's urine. About five times more curium was excreted in the urine than in the feces on the first day. Following this, however, partitioning of curium between urine and feces in the daily excretion was more nearly equal. A combination of total-body and partial-body counting of the living dogs utilizing the 209, 228, and 278 keV γ-rays of ^{243}Cm indicated that at a week after injection about 35% of the injected Cm was deposited in the liver and about 53% was in non-liver tissue (mainly skeleton). Three of the dogs were sacrificed, one each at 6, 13, and 20 days after injection. Although the liver and skeleton accounted for the bulk of the retained curium, some other tissues exhibited significant Cm concentrations, particularly the thyroid. (auth)

16052 COMBINED EFFECT OF DTPA AND CITRATE ON AN INTRAMUSCULAR ^{239}Pu DEPOSIT IN RATS. Volf, V. (Kernforschungszentrum Karlsruhe, Ger.). Health Phys.; 27: No. 1, 152-153(Jul 1974).

Work is reported in agreement with that of Baxter and Sullivan (Health Phys.; 22: 785 (1972)), which demonstrated the joint local action of DTPA and citrate after intramuscular injection of ^{239}Pu on gastrointestinal absorption and retention of ^{239}Pu chelates in rats. Citrate, while less effective than DTPA in increasing absorption, is more effective in increasing the amount retained. As to the action of both compounds, absorption of ^{239}Pu is twice that with DTPA alone but retention is held down to about the same proportion of the absorbed dose as with DTPA alone. (UK)

16053 EFFECTS OF DRUGS ON $^{47}Ca^{2+}$ MOVEMENTS IN DEPOLARIZED LONGITUDINAL SMOOTH MUSCLE. Banerjee, A. K. (Univ. of Glasgow). Arch. Int. Pharmacodyn.; 207: 148-161(1974).

The effects of smooth muscle stimulants and relaxants were examined for their effects on $^{47}Ca^{2+}$ movements in K_2SO_4 depolarized longitudinal smooth strips of guinea-pig ileum in vitro. Carbochol and acetylcholine induced contraction of the depolarized preparation and caused increase in the uptake of $^{47}Ca^{2+}$; no significant increase in the release was however observed. Histamine caused small contraction and was without any significant effect on either release or uptake, although histamine treated preparations generally showed higher radioactivity than the corresponding controls. 5-HT caused virtually no contraction and yet it was the only smooth muscle stimulant which caused marked increase in the release as well as in the uptake of $^{47}Ca^{2+}$. Adrenaline did not induce any mechanical change but caused increase in the efflux; influx, however, remained unaffected. Papaverine caused irreversible relaxation of the depolarized muscle and there was a concomitant increase in efflux and decrease in influx of $^{47}Ca^{2+}$. (auth)

16054 PECULIAR FEATURES OF THE MICRODISTRIBUTION OF THORIUM IN THE LUNGS OF RATS AFTER THE INTRATRACHEAL ADMINISTRATION OF ITS COMPOUNDS. Pavlovskaya, N. A.; Makeeva, L. G. Gig. Sanit.; No. 5, 29-33(May 1974). (In Russian).

The microdistribution of thorium in the sections of the rat's lungs after the intratracheal administration of thorium dioxide did not depend on the area or the lobe of the lung it was taken from. Irrespective of the solubility of the thorium compounds, the α particle tracks observed on autoradiograms of rat lung sections were irregularly distributed. The maximum amount of thorium accumulated in the interstitial tissues. (auth)

16055 EFFECT OF AMINOALKYLPHOSPHONIC ACIDS ON THE RATE OF REMOVAL OF INCORPORATED $^{95}Zr-^{95}Nb$. Razumovskii, N. O.; Baranovskaya, L. M.; Torchinskaya, O. L. Gig. Sanit.; No. 3, 53-58(Mar 1974). (In Russian).

In tests on rats during a single intraperitoneal injection a series of aminoalkylphosphonic acids was studied with the purpose of accelerating the elimination from the organism of incorporated radionuclides of Zr and Nb. According to the efficiency of the limitation of the accumulation of $^{95}Zr-^{95}Nb$ in the organism the aminoalkylphosphonic acids as a rule were superior to the corresponding aminocarboxylic acids. The greatest effect was found during tests with ethylene diamindimethylphosphonic acid and 2,2'-diaminodiethylsulfide-$N_1N_1N_1'N'$-tetramethylphosphonic acid. Diethylenetriaminpentaacetic acid was inefficient with respect to the elimination of ^{95}Nb from the organism. (tr-auth)

16056 INTRACELLULAR DISTRIBUTION OF THE RADIOCOPPER DERIVED FROM CERULOPLASMIN AND FROM ALBUMIN. Marceau, N.; Aspin, N. (Univ. of Toronto). Biochim. Biophys. Acta; 293: 338-350(6 Dec 1973).

[^{67}Cu]Ceruloplasmin and [^{64}Cu]- or [^{67}Cu]albumin have been injected intravenously into groups of rats fed copper adequate and copper deficient diets. At later times the rat livers were removed, homogenized, and the subcellular organelles separated by ultracentrifugation. The distribution of radioactivity in the subcellular fractions was measured. In addition, its association with proteins in the soluble fraction of cell and mitochondrial cytochrome c oxidase was measured following their separation by gel filtration and polyacrylamide gel electrophoresis. The ^{67}Cu from ceruloplasmin and the ^{64}Cu from albumin became attached to intracellular proteins in the soluble fraction having approximate mol. wt of 30,000 and 10,000, respectively. The ceruloplasmin copper was also found to be tightly bound and the albumin copper loosely bound to cytochrome c oxidase. This suggests that within the specific time scales of these experiments the copper from ceruloplasmin becomes the functional, intrinsic copper and that albumin copper becomes the non-functional extraneous copper of cytochrome c oxidase. Similar studies have been performed on the subcellular distribution of radioactive copper in the rat brain and spleen. In these organs, ceruloplasmin copper similarly appeared in a cytoplasmic protein of 30,000 mol. wt, whereas albumin copper, by contrast, was detected in many protein fractions. (auth)

16057 EFFECT OF VALENCY AND TYPE OF ^{239}Pu CHEMICAL COMPOUND ON ITS DISTRIBUTION IN THE BODY. Khalturin, G. V.; Sevost'yanova, E. P.; Zhuravleva, A. K.; Buldakov, L. A. (Inst. of Biophysics, Moscow). Gig. Sanit.; No. 5, 38-42 (May 1974). (In Russian).

In the case of intravenous introduction of various compounds of ^{239}Pu to rats its distribution in the body depends on its physicochemical state in the solution, i.e., valency, tendency to hydrolysis, and to formation of complexes, etc. The more stable is the complex compound and the less is its tendency to hydrolysis, the less Pu accumulates in the liver and spleen, and the more in the skeleton and kidneys. (auth)

16058 TRANSFER OF STRONTIUM-90 FROM THE FISH ORGANISM TO PROGENY. Kulikova, V. G.; Beregovaya, E. I.; Kulikov, N. V. Sov. J. Ecol. (Engl. Transl.); 3: No. 4, 328-331 (1972).

Translated from Ekologiya; 3: No. 4, 48-52(1972).

The accumulation of ^{90}Sr in the bodies of sexually mature females of two species of aquarium fishes, Lebistes reticulatus which give birth to live young and egg-laying Macropodus opercularis, was studied under experimental conditions, considering the penetration of the radionuclide into the forming roe separately. It was established that by the time of spawning the content of ^{90}Sr in the roe of the guppy reaches 4 to 6% of the total content in the body of the female, while in the roe of Macropodus it is about 0.1%. The differences noted in the accumulation of the radionuclide are explained by the different degree of development of the roe in the bodies of the fish species studied. (auth)

16059 EFFECT OF ESTROGENIZATION ON THE DISTRIBUTION OF RADIOMERCURY IN QUAIL. Nishimura, M.; Urakawa, N. (Tokyo Univ.). Jap. J. Pharmacol.; 22: No. 4, 535-543(Aug 1972).

The effect of estrogenization on the distribution of ^{203}Hg was studied in male and immature female quail, as compared with laying ones. The concentrations of blood mercury were maintained at a higher level in laying quail than in male ones. In the laying quail, high concentrations of mercury in the blood were derived from the plasma mercury. Mercury excreted into feces and urine was less in laying quail than in male ones. However, a considerable amount was found in yolk of eggs laid during the observation period. The estrogenization induced an increase in plasma mercury, a decrease in the amount of mercury in the liver and the kidneys, and a reduction of mercury excreted into feces and urine. The effect of the estrogenization depended on the dose of estradiol benzoate. It is suggested that mercury in the blood plasma of laying quail is closely related to some components appearing in the plasma in response to estradiol benzoate and is transported into ovarian follicles together with those plasma components. (auth)

16060 EFFECT OF VARIOUS DRUGS ON THE DISTRIBUTION OF ^{65}Zn IN EHRLICH ASCITES CANCER-BEARING MICE. Suzuki, S. (Gunma Univ., Maebashi, Japan); Ogawa, E.; Tsuzuki, H. Kitakanto Igaku; 23: No. 2, 103-113(Mar 1973). (In Japanese).

Various drugs (anti-cancer agents, chelating agents, amino acids and salts) were injected ip with ^{65}Zn into Ehrlich ascites cancer-bearing mice, and the tissue distribution of ^{65}Zn was investigated. Mitomycin C (200 μg/mouse), Toyomycin (50 μg/mouse) and Nitromin (500 μg/mouse) had no effects on the distribution of ^{65}Zn. Merphyrin (500 μg/mouse) caused a decrease in ^{65}Zn uptake by cancer cells without any effects in the other organs. EDTA and BAL (each 1 mg/mouse) inhibited ^{65}Zn uptake by cancer cells and conversely elevated its concentration in ascites supernatant. BAL elevated also ^{65}Zn concentration in various other organs. Tetracycline, dihydrothioctic acid and Na-thioglycolic acid (each 1 mg/mouse) did not affect the ^{65}Zn uptake by cancer cells. Penicillamine (D- and DL-type, each 1 mg/mouse) caused a decrease of ^{65}Zn concentration in cancer cells with an increase of its concentration in the other organs. Cysteine, histidine, and glycine (each 1 mg/mouse) had no effects on the ^{65}Zn distribution. Various salts (each 0.1 ml of 3.5×10^{-2}M solution was injected per mouse) also affected organ distribution of ^{65}Zn. $ZnSO_4$, $CoCl_2$, and $NiSO_4$ inhibited the uptake of ^{65}Zn by cancer cells, however, $MgCl_2$, $MnSO_4$, $FeCl_2$ and $CuSO_4$ had no effects on it. In ascites cancer cells, the highest concentration of ^{65}Zn was found in supernatant fraction, next in nuclear and microsomal fraction. The mitochondrial fraction contained the lowest amount. All of the above drugs had no effect on the intracellular distribution pattern of ^{65}Zn in cancer cells. (auth)

16061 ORGAN DISTRIBUTION OF ^{65}Zn IN EHRLICH ASCITES CANCER-BEARING MICE. Suzuki, S. (Gunma Univ., Maebashi, Japan); Ogawa, E.; Tsuzuki, H. Kitakanto Igaku; 23: No. 2, 93-102(Mar 1973). (In Japanese).

The tissue distribution of ^{65}Zn injected intraperitoneally or subcutaneously into Ehrlich ascites cancer-bearing mice was followed during a 24-h period. (CH)

16062 LOCALIZATION AND DISTRIBUTION OF ^{32}P IN THE RAT AFTER PHOSPHORUS BURN. Appelbaum, J. (Hebrew Univ., Jerusalem); Shani, J.; Givant, Y.; Ben-Hur, N.; Schlesinger, J. pp 425-432 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Phosphorus burns were induced in male mature rats by ignition of 100 mg phosphorus labeled with ^{32}P (with a specific activity of 2 μCi/mg) in an incision made in the inguinal region. Distribution studies in body tissues, as well as sub-cellular localization of ^{32}P in its major target-organs, were carried out at various intervals from five hours up to five days post-burn. During the experiment, the rats were kept in metabolism cages and their urine collected at certain intervals. Upon sacrificing, organ specimens were processed and counted for radioactivity, while blood and urine samples were analyzed for electrolytes, creatinine clearance, alkaline phosphatase, osmolality, and ^{32}P content. Phosphorus-32 was detected in the blood and was concentrated in the liver, kidney, and adrenal glands shortly after the burn. The quick concentration of ^{32}P in these organs was reciprocal to its concentration in the blood. Autoradiographic studies were performed at various intervals up to five days after the burn, and showed a marked transfer of ^{32}P into the hepatic parenchyma and the kidney. Both the glomeruli and tubuli of the kidney were loaded with the tracer, pointing towards the mechanism of action of the phos-

phorus burn. The glomeruli exhibited a heavy proliferation of the epithelial cells, partially plugging its urinary space, while remarkable necrosis was noticed in the tubuli, plugging the proximal tubules with cell debris. Electron microscope autoradiography was performed on some of the organs including the kidney, liver, adrenal, hypothalamus, and hypophysis and confirmed the cytoplasmatic necrosis as well as the heavy damage in the Golgi apparatus. The findings were reflected in the impaired diuresis and electrolytic balance and explain the anurea and polyurea processes as probably due to plugging of urinary space and damage of the glomerular structure, leading to kidney insufficiency. (auth)

Plants

Refer also to abstracts 15377, 15446, and 16095.

16063 AVAILABILITY OF STRONTIUM-90 TO VARIOUS EGYPTIAN PLANTS THROUGH ENVIRONMENTAL CONTAMINATION. Roushdy, H. M.; Abdel Salam, M. A.; Moloukhia, M. K.; Abdel Latief, S. b. (Atomic Energy Establishment, Cairo). pp 259-269 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

Absorption of strontium-90 by cucumber and moloukhia plants was studied under greenhouse conditions. The experiment was carried out in three replicated series and the plants were raised on Egyptian clay soil. The cucumber has broad hairy leaves, shallow roots, and is known to be non-calcium-loving while the moloukhia has small slimy leaves, tap roots, and is known to be calcium-loving. Equal amounts of activity were applied either to the leaves or to the soil, 30 days after cultivation. Samples were collected for analyses 1, 2, 4, 7, 11, 17, 22, and 27 days following strontium-90 application. The results obtained showed that the two plants differed with respect to strontium-90 uptake. Under conditions of soil application, a relatively higher activity was associated with moloukhia than with cucumber, whereas under foliar application the cucumber retained the higher activity due to its large-sized hairy leaves. In general, however, both plants showed higher uptakes with foliar as opposed to soil application. Autoradiography confirmed the translocation of strontium-90 through metabolic paths of the contaminated plants. The total radioactivity increased, in general, with time. The pattern of distribution of activity in the plant was: leaves ≫ lower stem parts > upper stem parts > fruits > roots. (auth)

16064 ^{210}Po DISTRIBUTION IN PLANTS. Powers, G. E. Fort Collins, CO; Colorado State Univ. (1973). 137p. University Microfilms Order No. 74-5440.

Thesis (Ph. D.).

Unsupported ^{210}Po used as radionuclide fuel for SNAP electrical generators presents a potential hazard if accidentally released in an agricultural area. Polonium dioxide formed from combustion would be the chemical form deposited on the soil. Techniques of ultracentrifugation, gel filtration, amino acid analysis, autoradiography, and nutrient deficiencies were employed to investigate the nature of polonium in plants after the uptake of $^{210}PoO_2$ from the soil. Organelle separation studies of sugar beet leaves and oat leaves indicated that 75 to 91 percent of the ^{210}Po was associated with the endoplasmic reticulum and that the remaining ^{210}Po was distributed among the remaining cell organelles, cell wall, and non-sedimenting molecules. Gel filtration of both sugar beet leaf and oat leaf homogenates indicated that approximately 8 to 10.5 percent of the ^{210}Po was associated with molecules of molecular weights of 70,000 daltons and 145,000 daltons in each type of plant. Amino acid analysis of a selenium accumulating plant, Astragalus osterhoutii, suggested that small amounts of ^{210}Po may be associated with amino acids forming Po-methylpolonocysteine and polonocystathionine. A non-selenium accumulator plant, Avena sativa, gave no indication that ^{210}Po was associated with amino acids. Autoradiography of bean stems indicated that ^{210}Po was bound near the cell wall and in membranes and not in a colloidal state within the plant tissue. Kinetic uptake studies of $^{210}PoO_2$ in four species of plants gave insufficient evidence that the absence of calcium, sulfur, phosphorus, or nitrogen affected the $^{210}PoO_2$ uptake in plants grown in radioactive nutrient media. (Diss. Abstr. Int., B)

16065 CHROMOSOME REARRANGEMENTS INDUCED BY ^{3}H-THYMIDINE IN CREPIS CAPILLARIS. Shevchenko, V. V. (Inst. of Developmental Biology, Moscow). Sov. Genet. (Engl. Transl.); 7: No. 5, 563-568(May 1971).

Translated from Genetika; 7: No. 5, 15-22(May 1971).

The nature of the cytogenetic effect of ^{3}H-thymidine after treatment of Cr. capillaris sprouts for 6 h with a solution of 20 μCi/ml was studied. It was found that in the first cellular cycle, ^{3}H-thymidine induces aberrations only after incorporation into the chromosomes in the S-period, since no aberrations arose in the cells in G_1 and G_2 during treatment. In the second cellular cycle, chromosome breaks occurred in all the phases, and therefore, in contrast to the first cycle, chromosomal aberrations were observed together with chromatid aberrations. The ratio of different types of chromatid aberrations induced by ^{3}H-thymidine in the S-period differed from the ratio observed after x-irradiation (especially high percentage of chromatid deletions and gaps) and closely coincided with the ratio observed after treatment of the sprouts with strontium-90–yttrium-90. The localization of chromosome breaks in the two types of aberrations (isochromatid deletions and chromatid translocations) was the same as after irradiation with other types of radiation (x-rays, 120 MeV protons, neutrons, ^{90}Sr). It was hypothesized that the high frequency of breaks in individual regions of the chromosomes observed after the influence of certain chemical mutagens is not associated with the amount of thymidine or peculiarities of DNA replication in these regions. (auth)

16066 INFLUENCE OF SOIL MOISTURE CONTENT ON STRONTIUM-90 UPTAKE BY PLANTS. Molchanova, I. V.; Karavaeva, E. N.; Kulikov, N. V. (Inst. of Plant and Animal Ecology, Moscow). Sov. J. Ecol. (Engl. Transl.); 3: No. 3, 257-259(1972).

Translated from Ekologiya; 3: No. 3, 78-80(1972).

Data are presented from studies on the ^{90}Sr uptake by plants as a function of soil moisture content, taking into account the changes in radioisotope concentration in the soil solution. (auth)

Microorganisms

Refer also to abstracts 15455 and 18115.

16067 (CONF-730228-, pp 319-328) EFFECT OF HEAVY WATER ON REGULATORY PROPERTIES OF PHOSPHOHEXOSE ISOMERASE IN LACTOBACILLUS CASEI. Pradhan, P. G.; Nadkarni, G. B. (Bhabha Atomic Research Centre, Bombay). 1973.

From symposium on control mechanisms in cellular processes; Bombay, India (1 Feb 1973).

The growth inhibition of Lactobacillus casei in a medium prepared in D_2O is being investigated with reference to activities of some fermentative enzymes. Phosphohexose isomerase purified from this bacterium showed striking variations in respect of allosteric interactions. Erythrose-4-phosphate inhibited this enzyme allosterically in H_2O medium, but in D_2O this compound merely acted as a competitive inhibitor. The transition of the inhibition kinetics from sigmoidal to hyperbolic relationship indicated conformational changes in the protein. The enzyme preparation in heavy water was considerably stable to heat though more sensitive to the inhibitor. Properties of this enzyme and the significance of these variations are presented. (auth)

New Tracer Techniques

Refer also to abstracts 14748, 14749, 14758, 14759, 14786, 14793, 14858, 15037, 15081, 15472, 15473, and 15523.

16068 (ANL-8080, pp 3.1-3.33) PROTON RADIOGRAPHY IN THE DETECTION OF TUMORS AND STROKES. Steward, V. W. (Univ. of Chicago). 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

The first application of proton radiography to human material was made by Steward and Koehler. In this report, some of the initial results of the investigations are described and, because of the novelty of the approach, those properties of protons are summarized that allow the production of unusually high contrast radiographs. In addition, the potential of the method for diagnostic medicine is demonstrated and an indication given of the direction that this development may take in the future. (auth)

16069 (UCD-472-120, pp 50-53) MULTIPLE RADIONUCLIDE LABELING METHOD FOR IN VIVO DETERMINATION OF BONE MARROW CELLULARITY. Wilson, F. D.; Momeni, M. H. Jun 1973.

In annual report, fiscal year 1973.

A method for in vivo quantification of bone marrow cellularity by multiple radioactive labeling (^{51}Cr, ^{59}Fe, ^{125}I-RISA, ^{131}I-RISA)

is described and some preliminary results are presented. Variations in cell counts due to hemodilution were corrected utilizing radioactive blood labeling techniques. Interpretation is limited by the small number of Beagles evaluated but data indicate a much more variable pattern of marrow cellularity for individual animals in radiation groups than for control animals. (auth)

16070 (UCD-472-120, pp 144-147) THYROID FUNCTION IN THE RAT: ^{131}I TRACER STUDIES. Book, S. A.; Wolf, H. G.; Rogers, Q. R.; Bustad, L. K. Jun 1973.

In annual report, fiscal year 1973.

Thyroid function parameters obtained in rats used in laboratory experiments included determination of changes in thyroid uptake and release of ^{131}I, thyroid weight, and thyroid hormonal changes as a function of administration of propylthiouracil (PTU) or high amounts of stable iodine or exposure to cold and low iodine levels. PTU and low I and cold exposure caused a 4-fold increase in weight and a fast release of ^{131}I from the thyroid. The 3 to 5 hr uptake values were 3 to 5% in controls and PTU fed groups and 60 to 80% in those exposed to cold and low I. Chromatography and autoradiography were used to show differences in labeled hormones in thyroid glands. (auth)

16071 LOCATION OF CATECHOLAMINES IN THE BRAIN USING THE $^{17}O(n,\alpha)^{14}C$ REACTION. Wassermann, I. (Weizmann Inst. of Science, Rehovot, Israel); Samuel, D.; Yuwiler, A.; Carpenter, B. S. Trans. Amer. Nucl. Soc.; 18: 85(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16072 LOCATION OF LITHIUM IN THE BRAIN. Carpenter, S. (National Bureau of Standards, Washington, DC); Samuel, D.; Wasserman, I. Trans. Amer. Nucl. Soc.; 18: 85-86(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16073 CADMIUM TOXICITY IN ADULTS AND EARLY LARVAL STAGES OF THE MUSSEL MYTILUS GALLOPROVINCIALIS LAM. Pavicic, J. (Rudjer Boskovic Inst., Rovinj, Yugoslavia); Jarvenpaa, T. pp 179-188 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The toxicity of cadmium, added as $CdCl_2$ into seawater (37 to 38‰ salinity, temperature 20 ± 1°C) was studied in adults and early larval stages of the blue mussel, Mytilus galloprovincialis Lam. Using cadmium-115m radiotracer, the rate of cadmium accumulation in adult specimens was estimated. For adults the critical toxic concentration range was found to be between 0.25 and 1 ppM of Cd^{2+}, with a thirty-day median tolerance limit at 0.36 ppM of Cd^{2+}. The tolerance toward cadmium did not increase significantly with increasing age except in the group of heaviest specimens tested (10 g). The product of the median survival time and the corresponding cadmium concentration was constant, showing an infinite toxicity type of reaction. In early larval stages the six-day median tolerance limit was about 3 ppM of Cd^{2+}, which was somewhat higher than the corresponding value in adults (1.8 ppM). The development to straight hinge veliger stage was blocked at 5 ppM of Cd^{2+} and the growth-rate of the same stage was retarded at a Cd^{2+} concentration in the experimental basin as low as 0.08 ppM. Bioaccumulation of Cd^{2+} was determined to be a function of Cd^{2+} concentration in experimental medium. At the end of the seventh day the concentration of Cd^{2+} in the organisms was 23 to 50 times higher than in the experimental basins containing 1.6 to 0.25 ppM of Cd^{2+}. (auth)

16074 KINETICS OF CHROMIUM ABSORPTION BY INTACT RICE PLANTS. Verfaille, G. R. M. (EURATOM, Wageningen, Netherlands). pp 315-331 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The kinetics of chromium uptake from an Hoagland solution by intact rice plants (Oryza sativa L. cv Arborio) was studied. The kinetic runs were performed in an experimental set-up specially designed for the study of the ion uptake in relation to the physiology of the plant mineral nutrition. The uptake was followed by labelling the chromium compounds with ^{51}Cr. In the total amount of chromium retained by the plants, a distinction must be drawn between a sorbed fraction and an assimilated one. When Cr(III) is chelated with EDTA, the chromium enters the roots extremely slowly, but the small amount taken up is readily transported over the entire plant. When the chromium is delivered to the roots in the form of chromic or chromate ions, the chromium is extracted from the solution at a much higher rate but less than 2% of it is assimilated and transported to the aerial parts. The behavior of the chromate ions is identical to that of the chromic ions after the former have been reduced to the latter by the bio-organic matter of the roots. As far as the aerial parts are concerned, the plant mineral nutrition can never be considered as a dangerous vector of pollution of the food-chain by the chromium. However, if the roots themselves are part of the food-chain, the presence of unreduced chromate ions in the soil solution could form a dangerous contamination factor. (auth)

16075 METABOLISM OF LABELLED THIRAM IN BARLEY AND SOIL. Sane, P. V.; Rao, S. R.; Kumarasamy, R.; Murthy, N. B. K.; Raghu, K. (Bhabha Atomic Research Centre, Bombay). pp 351-361 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The fate and persistence of thiram (tetramethylthiuram disulphide), was studied in barley plants raised from seeds coated with ^{35}S-labeled thiram. Using barley plants grown for four weeks, the label was followed in different plant compounds using column and paper chromatography. The label was present in free and protein amino acids, organic acids, lipids, and neutral compounds. Apparently thiram or its degradation products were taken up by the plants. At all the stages of development the insoluble material contained over 40% of the label present in the shoot. Paper chromatography of free and protein amino acids showed that methionine and cyst(e)ine had acquired the label. The organic acids when chromatographed showed a number of acidic radioactive spots. These could be the precursors of sulphur-containing amino acids. Of the total label applied to a seed as thiram less than 4% was taken up by the shoot in the first four weeks. The fate of the thiram in the soil during this experiment was also studied. At the end of 7 days thiram accounted for less than 4% of the total activity in the soil, indicating a rapid chemical and microbial degradation of this fungicide. These studies also indicated that the fungicide and its degradation products tended to remain at the site of seed placement in the soil. In the experiment in which barley plants were grown to maturity, the label could be detected in several plant metabolites at all the stages of development. A large fraction of the label was present as sulphur-containing amino acids. During grain development a considerable amount of label was translocated to the spike. The spike accounted for less than 2% of the total activity applied as thiram to a seed and of this over 60% was present in the form of sulphur-containing amino acids. Only 0.5 μg equivalent of thiram was present per gram of spike, and of this only 20% at the most could be in the fungitoxic form. (auth)

16076 METABOLISM AND ACCUMULATION OF PESTICIDES IN RICE PLANTS. Ishizuka, K.; Hosaka, H.; Takase, I.; Tan, K. E.; Hirata, H. (Inst. of Physical and Chemical Research, Wako-shi, Japan). pp 363-372 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

A great variety of pesticides to improve the cultivation of rice plants have been developed and applied in quantity to the rice fields. Qualitative and quantitative studies on the contamination of pesticides in the grains and shoots are thought to be important to gain an understanding of the incorporation of pesticides into the food-chain and the environment. Utilization of radioactively labelled pesticides provides a prominent advantage for these purposes. ^{14}C-labelled herbidices, 2, 4, 6-trichlorophenyl 4'-nitrophenyl ether (CNP) and 2-tertiary-butyl-4-(2, 4-dichloro-5-isopropoxyphenyl)-5-oxo-1, 3, 4-oxadiazoline (Oxadiazon), and ^{32}P-labelled fungicide, O-ethyl S, S-diphenyl phosphorodithiolate (Hinosan) were radiochemically traced in rice plants. The herbicides, applied to the surface water of the paddy-field, were found to have accumulated in quantity in the stem within a few weeks of transplantation of the rice seedlings; they gradually became redistributed evenly throughout the whole plant. During the head-ripening, the herbicides and their derivatives produced by plant metabolism were carried into the heads, although the concentrations were found to be low. Some of the metabolic derivatives of the herbicides were discovered to translocate into the head parts much more than the parent herbicides. The existence of a permeability barrier between a stem and a head is proposed. The fungicide, applied to rice shoots during the stages of head-formation and milk-ripening—for protection against rice blast

disease, was found to have more accumulated in the heads than was the case for herbicides applied to the surface water at the seedling stage. By means of autoradiographic techniques combined with thin-layer chromatography and radiogaschromatography, pathways of metabolic breakdown of the pesticides in rice plants were studied. Dechlorination, ether cleavage, alkyl-oxidation, dethiophenylation, and dealkylation of these pesticides were found to take place. (auth)

16077 METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES XV. Translocation and Degradation of ^{32}P-Malathion in Bean and Cotton Plants. Mostafa, I. Y.; Fakhr, I. M. I.; El-Zawahry, Y. A. (Egyptian Atomic Energy Establishment, Cairo). pp 385-392 of Comparative Studies of Food and Environmental Contamination. Vienna; International Atomic Energy Agency (1974).

From symposium on nuclear techniques in comparative studies of food and environmental contamination; Otaniemi, Finland (27 Aug 1973). See STI/PUB-348; CONF-730817-.

The uptake of ^{32}P-labeled malathion by cotton (Gossypium barbadense) and broad bean (Vicia faba) plants was studied following both foliar application and entry via the root system. When immersed in a solution of the radioactive insecticide for 3 days, 11.1 and 38.2% of the applied dose were taken up by cotton and broad bean plants, respectively. On the other hand, 40 and 54.2% of the amounts applied on the upper surfaces of the leaves were recovered after one month in cotton and broad bean plants, respectively. The metabolic fate of malathion within the plant tissues was also investigated. Of the total radioactivity entering through the root system into the broad bean plant tissues, 77.4% was transformed into hydrolytic metabilites in three days, while in cotton plants the figure was 63.8%, both recovered from the aqueous layer following a chloroform-water separation. Analysis of the water fractions from both plant species revealed the presence of ^{32}P-labeled metabilic products of malathion: mono and di-acid derivatives, dimethyl phosphorodithioate, dimethyl phosphorothioate, dimethyl phosphate, monomethyl phosphate, and thiophosphate. Analysis of aqueous fractions following foliar application showed that all compounds found following root uptake were found with foliar uptake, though the dimethyl phosphorothioate was present in much lower quantities. (auth)

16078 PERIPHERAL JOINT IMAGING IN JUVENILE RHEUMATOID ARTHRITIS. Shuler, S. E.; Helvie, W. W. (Dept. of Nuclear Medicine and Pediatrics, New Orleans). S. Med. J.; 67: No. 7, 789-795(Jul 1974).

The pattern of isotope distribution using $^{99m}TcO_4$ in peripheral joints was evaluated in 21 children with known juvenile rheumatoid arthritis and seven with probable disease. Correlation is made with physical findings, x-ray films, and laboratory data. Joints most commonly involved in the former group (in order of decreasing frequency) were knees, wrists, ankles, elbows, hands, shoulders, and feet. Abnormal scans were obtained with equal frequency on each side of the body. In five patients with probable disease, all abnormal joints were in the lower extremities. Normal prepubertal localization of $^{99m}TcO_4$ in areas of new bone growth is described. Peripheral joint scanning is a simple, useful technique requiring a low radiation dose which provides detection and documentation of inflammatory processes affecting the joints even before they may be evident clinically or radiographically. Peripheral joint scanning and radiographic joint studies should be considered as complementary procedures. (auth)

16079 VALUE OF CARRIER-FREE ^{51}Cr AS A STOOL MARKER. Kerr, M. K.; Hitchman, A. J. W.; Husdan, H.; Rapoport, A.; Harrison, J. E. (Toronto General Hospital). Clin. Biochem.; 4: 233-240(Dec 1971).

The use of ^{51}Cr carrier free as a faecal marker has been investigated in the study of calcium metabolism. More than 95% of ^{51}Cr is excreted without absorption or abnormal retention in the gastrointestinal tract. ^{51}Cr and ^{47}Ca have similar transit times in the gut. Comparisons between tracer and stable chromium marker data showed agreement within ±5%. In 13 balance studies using 0.5 μCi of $^{51}CrCl_3$ three times daily in milk, estimates of faecal calcium excretion were found to be more consistent after corrections based on ^{51}Cr data allowed for irregularities and possible losses. It is concluded that isotopic Cr marker is more convenient than, just as reliable as, and probably safer (than stable chromium markers. (auth)

16080 ANOTHER LOOK AT THE LAW OF BERGONIE AND TRIBONDEAU. Shaeffer, J.; El-Mahdi, A. M. (Univ. of Virginia, Charlottesville). Beitr. Pathol.; 149: 408-410(Sep 1973).

Tumor-bearing mice were injected intraperitoneally with tritiated thymidine. Six hrs later the mice were killed and the tumors were removed. Differences in the radiation responses of radiosensitive and radioresistant mammary adenocarcinomata could not be explained on the basis of their comparable growth rates, labeling indices, or histopathological grades. (HLW)

16081 DISTURBANCE OF INTESTINAL CIRCULATION OBSERVED FROM ANALYSIS OF KINETICS OF ENDOTOXIN MEASURED BY THE RADIOIMMUNOASSAY METHOD. Tai, C. (Okayama Univ., Japan). Shindan To Chiryo; 62: No. 2, 309-313 (Feb 1974). (In Japanese).

In order to analyse the pathological conditions of intestinal ischemia, the endotoxin fluctuating with the intestinal ischemia was measured by the radioimmunoassay method. E. Coli 0111 lipopolysaccharide of Difco Co., Ltd. was employed as an antigen, being labeled with ^{125}I. The assay was carried out by the double antibody method. The measurable minimal concentration was 20 μg/ml. In the albino rabbits under anesthesia, the abdominal incision was performed, and the intestines were constricted with umbilical tapes at basal position of the superior mesenteric artery and 60 minutes later they were released. For elucidating the pathological mechanism after the intestinal ischemia, the endotoxemia, induced by the same procedure in the rabbits with decreased intestinal flora by treatments, was analyzed. Then, the disappearance ratio of tracer dose of labeled-endotoxin in the blood which was administered intravenously and its distribution in the organs were examined. Furthermore, the effects of the fluctuation of the disposing capacity of endotoxin under the shock or hepatic ischemia on blood pressure changes induced by the endotoxemia in the intestinal ischemic conditions were examined. The intestinal ischemia promoted the destruction of mucosal barrier, and enabled the endotoxin in the intestine to penetrate the wall. As soon as the constriction was released, a large amount of endotoxin entered rapidly the portal circulation. In the normal liver, most of the endotoxin entering the body was trapped to be removed, while in shock and ischemic liver, the removal was incomplete and damages of the tissue structure appeared in various organs. More than 70 blood samples were collected from patients who were supposed to have endotoxemia. As a result, endotoxin was demonstrated in 22 patients. The relationship between the pathological condition and endotoxin in the blood was examined. Especially a high incidence of endotoxemia was observed in the patients with biliary infectious disease with hepatic disturbances, and also in other infectious diseases, ileus, and ulcerative colitis. (JA)

16082 CLINICAL EVALUATION OF THE TUMOR SCANNING WITH ^{57}Co BLEOMYCIN. Suzuki, Y. (Kanazawa Univ., Japan); Hisada, K.; Hiraki, T. Kaku Igaku; 11: No. 1, 7-13(Feb 1974). (In Japanese).

Tumor scanning with ^{57}Co Bleomycin was performed for 35 selected patients. Five hundred micro curie of ^{57}Co Bleomycin was injected intravenously and two scintiphotos were taken at 6 hours and 24 hours after injection with a gamma camera. No patient had an untoward reaction to the radiopharmaceutical. Confirmed diagnosis was obtained in 27 out of 35 patients. Scintiphotos were positive in 15 out of 23 patients with malignant tumor (66%). This result is somewhat inferior to that of ^{169}Yb citrate and ^{67}Ga citrate. In lung cancer, positive rate was slightly higher i.e. 9 out of 12 cases (75%) and the best result was obtained in squamous cell type lung cancer: four out of five cases (80%). In laryngeal cancer, however, only one of three cases did show positive scan. There was no false positive case in four benign lesions. It is well known that Bleomycin has strong therapeutic effect to the squamous cell carcinoma, so it may be an interesting subject whether ^{57}Co Bleomycin has also specific affinity to the squamous cell carcinoma or not. Unfortunately we could not get any answer to this question from this study and we should do further study for this purpose. Cobalt-57 Bleomycin disappears rapidly from blood and is excreted mainly through the kidneys, so high tumor/blood ratio is acquired in a short time after injection. This might be the best characteristic of this pharmaceutical. There is no specific organ to which ^{57}Co Bleomycin has special affinity other than kidneys, so it is easier to find the area of abnormal activity. Sometimes this characteristic, however, makes difficult to get information of anatomical site of the lesion. Cobalt-57 has ideal energy γ rays for scanning, but its 270 days physical half life might be too long. Since ^{57}Co Bleomycin is excreted rapidly, there might be no problem in radiation dose to the patient, however, many problems in disposal of patients wastes. Long physical half life may restrict the routine use of this radiopharmaceutical in tumor clinic. Cobalt-57 Bleomycin has many good properties, so this should be used in selected patients adjunct to other diagnostic study. (auth)

16083 RADIOIMMUNOASSAY OF GASTRIN. Principle of Method and Measurement of Gastrin in Single Antibody System by Dextran Coated Charcoal. Morita, N.; Odawara, R.; Arima,

K.; Nakao, Y.; Futagawa, T. . (Kagoshima Univ., Japan). Kagoshima Daigaku Igaku Zasshi; 25: No. 3, 257-263(Dec 1973). (In Japanese).

The single antibody radioiodine immunoassay technique with the use of the CEA-IRE-SORIN KIT is described. The kit contains the freeze-dried reagents to perform this analysis: the radioiodine labelled gastrin, the standard gastrin, and the specific antiserum. The binding capacity in percentage is 38.0 to 58.5%. Plasma gastrin and standard gastrin show parallel inhibition curves against the labeled gastrin. The antiserum studied here had a sharp dose-response curve. The sensitivity of this immunoassay is sufficient to measure endogenous human gastrin in the majority of fasting normal human plasmas and hospitalized patients plasmas without recognized gastrointestinal diseases. The sensitivity of the assay is presently at least sufficient to measure less than 12.5 pg/ml of porcine gastrin I. Reproducibility of determinations on a group of plasma samples, which contained low concentrations of hormones, and which were assayed on different dates, is sufficient. The mean fasting serum gastrin level for the normal population was 81.2 pg per ml(± 35 SE). (auth)

16084 SIMPLE RADIOIMMUNOASSAY OF PLASMA ESTRADIOL-17 BETA, ESTRIOL, PROGESTERONE. Makino, T. (Teikoku Hormone Mfg., Co. Ltd., Japan). Nichidai Igaku Zasshi; 33: No. 3-4, 155-170(Apr 1974). (In Japanese).

By immunizing rabbits, estradiol-17 β (E_3)-antiserum, estriol (E_3)-antiserum and progesterone (P)-antiserum were prepared from E_2-6-oxime-bovine serum albumin (BSA), E_3-6-oxime BSA and P-3-oxime-BSA, which had been synthesized from 6-oxo-E_2, 6-oxo-E_3 and 20 β-hydroxy-P via (0-carboxymethyl) oxime. Each antiserum obtained had high titre and high specificity for E_2, E_3, and P respectively. The steroids dominant in plasma sample showed little or no detectable cross reaction with these antisera, so a simple radioimmunoassay of omitting column chromatography was investigated. As a result, plasma E_2 and E_3 of gravid females and plasma P of men and women were applicable to this method. The correlation of assayed plasma steroid values between with and without column chromatography were satisfactory. The accuracy and precision of the method were good. The lower limit of accurate quantitation was 20 pg per sample under this assay procedure. Using the methods one technician can assay 50 plasma samples in duplicate plus two parallel standards in one day. (auth)

16085 POSSIBILITY OF RADIONUCLIDE LABELING OF NERVOUS TISSUE. Greitz, T.; Widen, L.; Asard, P. E. (Karolinska Sjukhuset, Stockholm). Neuroradiology; 6: No. 3, 113-120 (Nov 1973).

In an attempt to investigate the possibilities of clinical scanning of the nervous system, primarily in the peripheral nerves, the uptake of theoretically suitable labelled substances (tetanus toxoid, amino acids, glucose, and dehydroascorbic acid) in nerves, spinal cord, and brain was measured in rabbits and mice, and compared with that in blood, muscle etc. The amino acids were taken up in higher concentration in the peripheral nerves following intramuscular than intravenous injection. An increased uptake in the nerve innervating the injected muscle suggests the existence of an axonal flow from the muscle in a proximal direction along the nerve. The concentration of the tracers tested in peripheral nerves was inadequate for clinical scanning. On the other hand, the concentration of glucose in the brain may permit the scanning of normal brain tissue, which should make possible a new and theoretically different method of brain scanning. (auth)

16086 SCINTIGRAPHY OF THE BONE MARROW. I. Experimental Study of Bone Marrow Labeling With Indium. Preliminary Results in Man. Rain, J. D.; Eberlin, A.; Boulard, M.; Dresch, C.; Najean, Y. (Hopital Saint-Louis, Paris). Nouv. Rev. Fr. Hematol.; 13: No. 6, 789-802(Nov 1973). (In French).

A specific uptake of radioactive indium to the plasma transferrin may be obtained on the condition that this protein is not saturated with iron; in these conditions the tracer is found for about 50% in the erythropoietic bone marrow. Scintigrams of the bone marrow have been obtained in several pathological conditions. However a quantification of the bone marrow density and its extend will be only possible when several other problems are resolved: standardization of plasma labelling, exact knowledge of the kinetics of the labelled transferrin, and percentage of the hepatic uptake. (FR)

16087 USE OF AN IMMUNOSORBENT FOR RADIOIMMUNOASSAY OF PLASMATIC ALDOSTERONE. Bizollon, C. A.; Riviere, J. F.; Claustrat, B. (Univ., Lyon). Ann. Endocrinol. (Paris); 34: No. 6, 725-727(Nov 1973). (In French).

A radioimmunoassay of aldosterone, using a cellulose-coupled antibody, is described. The method resulting from the use of such a system gives results more reproducible than those obtained by usual separation procedures. On the other hand, coupling of antibodies on a solid phase seems to increase their affinity for aldosterone. Moreover, by the use of this technique, there does not appear any blank in the reaction. (FR)

16088 EXAMINATION OF CELLULAR IMMUNITY IN MEASLES BY MEANS OF A ^{51}Cr RELEASE CYTOTOXIC TEST. Yamanka, T.; Chiba, T.; Nakao, T. (Sapporo Medical Coll.). Igaku No Ayumi; 88: No. 5, 203-204(Feb 1974). (In Japanese).

In order to examine cellular immunity in measles, ^{51}Cr release cytotoxic test was performed using peripheral lymphocytes and HeLa cells continually infected with measles virus (HeLa MV). As controls, HeLa cells without measles virus infection were used simultaneously. ^{51}Cr-labeled cells were prepared by adding Rachromate Na_2CrO_4 to each cell suspension for incubation at 37° for 60 minutes. Lymphocytotoxicity test by ^{51}Cr release was performed. To 0.5 ml of the ^{51}Cr labeled cells (3.0×10^4 to 5.0×10^4/ml), 0.5 ml of the lymphocyte suspension (3.0×10^6 - 5.0×10^6/ml) was added as the effector release group and 0.5 ml of culture solution in place of the lymphocyte suspension was added as the spontaneous release group. With the group of labeled cells alone as the maximal release group, the samples of these three groups were cultivated in a CO_2 culture apparatus at 37°C. After culture, three samples each were taken out for the three groups at 2, 12, 18, 24, and 36 hours. After centrifugation at 2000 rpm for 15 minutes, the solution was separated into the supernatant and the cell constitution. Radioactivity of each fraction was measured to obtain the cytotoxicity index (CI). The difference of CI between HeLa MV and HeLa was considered specific immune release (SIR). The results are summarized below. No SIR was observed in three of the four cases with HI antibody titer of below 8-fold with no anamnesis of measles. SIR of 8 to 24% was observed in all of the seven cases without the anamnesis of measles but with a positive HI antibody titer. In children with measles, SIR of 20 to 41% by peripheral lymphocytes was observed already on the 4th day after the onset of eruption. No significant difference was observed between the SIR of patients with measles encephalitis and that of measles children with a routine course. SIR reached the maximum in 12 to 14 hours after culture but tended to be masked after the 24th hour by increased spontaneous release. (JA)

16089 WHOLE-BODY COUNTING: ANALYSIS OF RETENTION DATA FOR ISOTOPES HAVING PROMINENT FECAL EXCRETION. Heaney, R. P. (Creighton Univ., Omaha, NE). J. Lab. Clin. Med.; 84: No. 1, 1-5(Jul 1974).

Excretion rates calculated from a curve fitted by standard least-square methods to retention data were found to be substantially less than actual measured excretion. A new method for fitting retention curves to experimental data was developed. Data were obtained from 24 ^{47}Ca retention studies in dogs and ten human subjects. Full metabolic balance conditions were employed to provide external validation of the conclusions derived from whole-body counting studies. For the dogs, the system consisted of two fixed 3-in. NaI detectors, 100 in. apart, with the dog fixed in a harness at the midpoint of, and in a plane perpendicular to the interdetector axis. Human subjects were counted with an Ohio Nuclear whole-body scanner, equipped with slit-collimators and direct-reading X-Y position transducers. (HLW)

16090 MEASUREMENT OF RED CELL DESTRUCTION IN THE SPLEEN. Williams, E. D.; Szur, L.; Glass, H. I.; Lewis, S. M.; Pettit, J. E.; Ahuja, S. (Hammersmith Hospital, London). J. Lab. Clin. Med.; 84: No. 1, 134-146(Jul 1974).

A method is described for measuring red cell destruction in the spleen. The accumulation of ^{51}Cr-labeled red cells in the spleen was studied using stationary external counters, and expressed as a percentage of the radioactivity injected by calibrating the counters for each patient. This calibration was effected by measuring the increase in count rate over the spleen following uptake of ^{51}Cr-labeled, damaged red cells given by a second injection. A quantitative dual detector scanning technique was used to measure this splenic radioactivity. The rate of loss of ^{51}Cr from the spleen was also measured by quantitative scanning, and a correction was made for this loss in calculating the average daily rate of red cell destruction. The rate of red cell destruction in the spleen in two patients with approximately normal mean cell lifespans was 0.2 per cent per day (representing 13 and 23 per cent of total red cell destruction). In 20 patients with marked hemolytic anemia, the destruction rate in the spleen could exceed 6 per cent per day, and in some cases virtually all red cell destruction took place in the spleen. The indices usually obtained by a surface counting study provide only an indication of the rate of red cell destruction in the spleen; the role of the spleen can be better described by measuring the fraction of the total red cell destruction occurring in the spleen. (auth)

16091 RADIOISOTOPIC METHODS IN THE DIAGNOSIS OF PULMONARY EMBOLISM. Vopez-Majano, V. (Veterans Ad-

ministration Hospital, Hines, IL). Int. Surg.; 59: No. 1, 35-39 (Jan 1974).

The diagnostic value of lung scintigrams are compared with radiographic studies for the evaluation of regional ventilation and blood flow in patients with suspected pulmonary embolism. Results are reported from scintigraphic studies of ventilation following administration of gaseous ^{133}Xe or ^{85}Kr and studies of blood perfusion following administration of albumin microspheres labeled with ^{131}I, ^{113m}In, or ^{99m}Tc. (CH)

16092 OVERNIGHT RADIOIMMUNOASSAY FOR HUMAN LUTEINIZING HORMONE. Brown, L. P.; Besch, P. K.; Buttram, V. C. Jr.; Fleischer, N. S.; Skelley, D. S. (Baylor Coll., Houston, TX). J. Lab. Clin. Med.; 84: No. 1, 129-133(Jul 1974).

A radioimmunoassay procedure for luteinizing hormone in serum or plasma was developed in which the assay mixture is incubated at 37°C for a total of 22 hours rather than at 4°C for 4 to 7 days. The within-assay coefficients of variation for the 37°C and 4°C methods, respectively, are 8.5 and 4.7%, while the between assay variations are 17.0 and 15.1%. Values at 4° C (y) were related to values at 37°C (x) according to the equation x = 1.4y + 0.6 with a correlation coefficient of 0.86. (auth)

16093 USE OF OPSONIZED, RADIO-IODINATED ALBUMIN FOR THE DETERMINATION OF TETRACYCLINE EFFECTS ON PHAGOCYTOSIS IN VITRO. Hoag, S. G. Lafayette, IN; Purdue University (1973). 145p. University Microfilms Order No. 74-4974.

Thesis (Ph. D.).

A method was developed for the determination of phagocytosis in vitro. The method utilized opsonized, radio-iodinated bovine serum albumin (^{125}IBSA) as the particles to be phagocytosed and leukocytes from the peripheral blood of humans. Phagocytosis was studied while the leukocytes were in undiluted blood without extensive manipulation of the cells prior to study. Separation of the leukocytes from the whole blood and from the non-ingested ^{125}IBSA was demonstrated to be adequate. Separation procedures were verified by demonstration that leukocyte washing procedures removed all removable ^{125}IBSA from blood samples; demonstration that erythrocytes remaining in final leukocyte suspensions did not contain ^{125}IBSA; and demonstration that dilution with carrier bovine serum albumin (BSA) did not reduce the constant, low level of ^{125}IBSA remaining in suspensions of leukocytes which were not actively undergoing phagocytosis. The method proved to be valid for the determination of phagocytosis. Verification of the method involved demonstration that phagocytosis of ^{125}IBSA was decreased in the presence of excess carrier BSA; demonstration that phagocytosis of ^{125}IBSA was opsonin dependent; demonstration that the rate of phagocytosis of ^{125}IBSA was as expected for a phagocytic process; and demonstration that phagocytosis of ^{125}IBSA was inhibited by iodoacetate, a known inhibitor of phagocytosis. The method was utilized to determine the effects of tetracycline HCl (TET) on phagocytosis. The TET was demonstrated to have no effect on phagocytosis of ^{125}IBSA at TET concentrations of 4.0 mcg./mL. to 325 mcg./ml. The TET caused statistically significant stimulation of phagocytosis at concentrations of 350 mcg./ml. and 375 mcg./ml. Statistically significant inhibition of phagocytosis was produced by TET concentrations of 450 mcg./ml. to 1000 mcg./ml. It was concluded that the method was sensitive and reproducible. The method appeared to be useful for the study of phagocytosis and for the determination of the effects of other drugs on the phagocytic process. (Diss. Abstr. Int., B)

16094 COMPUTER-CONTROLLED MEASURED-VALUE PROCESSING IN NUCLEAR MEDICINE. Gursky, S.; Boerner, K.; Dietrich, K.; Plotzki, A. (Karl-Marx-Univ., Leipzig). Isotopenpraxis; 10: No. 3, 114-119(Mar 1974). (In German).

The tasks that can be achieved by a computer in nuclear medicine are tabulated. The criteria to be used in the selection of the computer system are outlined and a typical computer configuration is described. The data flow in the computer system for a patient is schematized and the data processing outlined. (JSR)

16095 FATE OF CALCIUM IN THE INDUCTION OF INTERNAL DECLINE (SUAGARI) OF CITRUS RETICULATA BLANCO. Murakami, H.; Miura, Y.; Shimokawa, K. (Miyazaki Univ., Japan). Miyazaki Daigaku Kogakubu Kenkyu Hokoku; 19: No. 1, 127-136 (Sep 1972). (In Japanese).

An isotopic technique by using ^{45}Ca as a radioactive tracer to know fate of calcium in an induction of internal decline of Ponkan fruit (Citrus reticulata Blanco.) was attempted. A satisfactory method for measurement of ^{45}Ca absorbed in the fruit by using liquid scintillation counter was established. By using these procedures, the fate of ^{45}Ca in intact fruit and after storage was studied. Calcium-45 was absorbed by Ponkan fruit through stem and mainly located in peel. It was observed that the ^{45}Ca was transferred to pulp after storage for 30 days. Unfortunately there was no appearance of the internal decline of these fruits that absorbed ^{45}Ca. Therefore it could not prove a correlation of the fate of ^{45}Ca and of the induction of internal decline of Ponkan fruit. (auth)

16096 SIMPLE METHOD FOR ACCURATE ASSESSMENT OF THE GLOMERULAR FILTRATION RATE IN CHILDREN. Broechner-Mortensen, J.; Haahr, J.; Christoffersen, J. Scand. J. Clin. Lab. Invest.; 33: No. 2, 139-143(Apr 1974).

In 30 children with all degrees of reduced renal function, the total plasma clearance of (^{51}Cr)EDTA(Cl) determined after an intravenous bolus injection was compared to the (^{51}Cr)EDTA plasma clearance calculated from the final slope of the plasma curve (Cl_1), from the final slope and the first part of the plasma curve (Cl_2), and from the first part of the plasma curve (Cl_3). The determination of Cl_3, which demands the drawing of five blood samples within the first two hours after the injection, was found to be the most accurate of the three simplified single injection methods for assessment of the glomerular filtration rate. The short duration is also of importance for the applicability of the method. (auth)

16097 CADMIUM AVAILABILITY TO WHEAT: A STUDY WITH RADIOACTIVE TRACERS UNDER FIELD CONDITIONS. Stenstroem, T.; Loensjoe, H. Ambio; 3: No. 2, 87-90(1974).

A micro-plot method useful for studies of long-term variations in cadmium availability and the effect of cultivation practices such as fertilization and liming is presented. The uptake of cadmium from soils and different applications of sewage sludge was determined independently by use of sludge labeled with ^{109}Cd or ^{115m}Cd and by atomic absorption analysis of total cadmium It is indicated that even a limited use of sludge eventually may give concentrations of cadmium in agricultural products which are intolerable with regard to the WHO recommendations for human intake of cadmium. (auth)

16098 RADIOIMMUNOASSAY OF GASTRIN. Fasting Serum Levels In Humans With Normal and High Gastric Acid Secretion. Gedde-Dahl, D. Scand. J. Gastroenterol.; 9: No. 1, 41-47(1974).

A radioimmunoassay for gastrin giving accuracy, sensitivity, and precision parameters, using rabbit anti-albumin-SHG as antiserum and Dextran-coated charcoal for separation is described. In 298 patients with different diseases but with normal or high pentagastrin-stimulated gastric acid secretion fasting serum gastrin concentrations were determined. A mean of 65.9 (1 SD 42.2) pg/ml and a normal range of 10 to 150 pg/ml were found in the 205 patients with normal gastric acid secretion. No differences were found between sexes or age groups, nor was any difference found between patients with normal and high gastric acid secretion. No correlation was found between basal acid output or maximal acid output and fasting serum gastrin concentration in these patients. Persons with ulcus corporis ventriculi had significantly higher fasting serum gastrin levels than others whereas peptic ulcer patients did not differ from normals. (auth)

16099 STUDY ON CEREBRO-SPINAL FLUID DYNAMICS IN HYPERTENSIVE INTRACEREBRAL HEMORRHAGE WITH RADIOISOTOPE CISTERNOGRAPHY. Uemura, K.; Ito, Z.; Yamaguchi, K.; Kojima, S. (Research Inst. of Brain and Blood Vessels, Akita, Japan). No To Shinkei; 25: No. 2, 1561-1566(Dec 1973). (In Japanese).

Isotope cisternography using ^{169}Yb-DTPA was performed on twenty patients with hypertensive intracerebral hemorrhage, which included 13 cases treated surgically and seven cases treated conservatively. Abnormal findings were observed on 17 cases out of 20 cases of hypertensive intracerebral hemorrhage and its findings were as follows; delayed cerebrospinal fluid (CSF) flow was observed on 13 cases out of 20 cases. On three cases with large hematoma, marked delay in progression of the tracer at the spinal region was observed. Delay of CSF flow was more prominent on large hematoma group than small one. Ventricular filling of radioactivity was detected on three cases, all of which were examined after the long interval from the onset and were treated surgically. Persistent ventricular filling with the enlarged lateral ventricles and delayed CSF flow were observed on one case, which seemed to be normal pressure hydrocephalus cisternographically. The other two cases showed transient ventricular filling without delayed CSF flow. These might be due to cerebral atrophy after the cerebral hemorrhage. Asymmetrical spread of radioactivity over the cerebral convexity was observed on 12 cases. On all the cases, the poor distribution of the tracer was detected over the diseased hemisphere. This finding was possibly related to subarachnoid block induced by cerebral mass and adhesion of the subarachnoid-membrane. (auth)

16100 PROSTAGLANDIN. Sato, K.; Kinoshita, K.; Sakamoto, S. (Tokyo Univ.). Horumon To Rinsho; 21: No. 3, 245-249(Mar 1973). (In Japanese).

Radioimmunoassay (RIA) of prostaglandin (PG) is described.

PG2α combined with bovine serum albumin was used as antigen and antibody was made by immunizing this antigen in rabbit. PG was extracted and separated by column chromatography using silicic acid. PGF1α and PGF2α could not be separated. PG2α was labeled with ^{3}H. Bound type with antibody was separated by dextran-coated charcoal solution. According to the standard curve, the sensitivity ranged from 0.1 to 5 ng. Specificity of reaction to various PG was investigated and obstruction to bonding of PGF2α with antibody was measured. Cross reaction of various PG was 19.2% in E 1, 14.7% in F 1α, 0.39% in A2 and 0.03% in A. 0 to 7.5 ng of PGF2α was added to maternal serum obtained in three days after delivery, and its precision was examined. As a result, percentage of the measured amount to expected amount was 96 to 100%. A literature review on RIA of PG was added. (JA)

16101 NUCLEOMEDICAL STUDIES ON THE RETICULOENDOTHELIAL SYSTEM IN THE BONE MARROW. VII. Bleeding-Induced Stimulation of the Marrow Reticuloendothelial Function. Okuyama, S.; Ito, Y.; Sato, T. (Tohoku Univ., Sendai). Sci. Rep. Res. Inst., Tohoku Univ., Ser. C; 19: No. 4, 154-159(1972).

Taking advantage of the enhanced marrow deposition of ^{113m}In-chondroitin sulfate colloid, immediate changes in the marrow reticuloendothelial (RE) function in rats following an acute blood loss was studied by the organ radioassay technique in parallel with erythropoietic response. The anemia from the acute blood loss was followed by a sequence of erythropoietic events: elevation of the erythroid mitotic index on day-1; elevation of the erythroid myeloid ratio in the bone marrow on day-3; relative reticulocytosis in the peripheral blood on day-3; and recovery of the peripheral hematocrit during the day-5 through day-7 period. Stimulation of the marrow RE function was observed on day-1 and day-2. This agreed with the onset of erythropoietic response, and was thought suggestive of involvement of factor(s) such as erythropoietin and the like. (auth)

16102 POSSIBLE USES OF CYCLOTRONS IN MEDICINE. Lorenz, W. J.; Hoever, K. H.; Wolber, G. Radiobiol.-Radiother.; 15: No. 1, 19-26(1974). (In German).

The Heidelberg compact cyclotron is an isochronous cyclotron that was constructed by AEG. Together with the research reactor TRIGA, Heidelberg and the isotope laboratories the cyclotron is housed in a radioprotected, windowless, and fully air-conditioned building. The final energies were for protons 21.5, for deuterons 10.5, for $^{3}He^{++}$-nuclei 28.0 and for α-particles 21.4 MeV. In the internal beam currents of 500 μa, in the external beam currents up to 100 μa are achieved. The cyclotron is used mainly for the production of radionuclides for basic research and for nuclear medical diagnosis and therapy. Other uses are in vivo and in vitro activation analyses, radiation biophysical and radiobiological examinations and the generation of fast neutrons for radiation therapy. For nuclear medical diagnosis the production of the following nuclides is feasible: ^{11}C, ^{13}N, ^{15}O, ^{18}F, ^{52}Fe, ^{62}Zn, ^{67}Ga, ^{77}Br, ^{81}Rb, ^{84}Rb, ^{111}In, ^{123}I, and ^{206}Bi. (auth)

16103 SCINTIGRAPHIC EXAMINATIONS OF SALIVARY GLAND DISEASES. Kessler, L.; Otto, H. J.; Theuring, F. Radiobiol.-Radiother.; 15: No. 1, 185-189(1974). (In German).

The results of scintigraphic examinations of head salivary glands are reported, a gamma-camera and ^{99m}Tc-pertechnetate being used. The results of examinations in different pictures of disease are demonstrated. Scintigraphy is shown to give an information gain compared with conventional methods expecially in the diagnosis of chronic sialoadenitides and in sialoses. Optic representation of the functioning parenchyma succeeds quickly and without loading to the patient. In sialomas autoradiographic examinations are made being compared with the scintigraphic results: a large agreement of the results of both methods is observed. (auth)

16104 POSSIBILITIES AND PROSPECTS IN DEVELOPMENT OF A RADIOISOTOPIC METHOD IN THE COMPLEX OF RADIATION DIAGNOSIS. Zubovskii, G. A. (Moscow Scientific-Research Rentgeno-Radiological Inst.). Vestn. Rentgenol. Radiol.; No. 2, 16-22(1974). (In Russian).

The use of radioactive isotopes for diagnostic purposes is reviewed. Radiometric, functional, and morphologic investigations using radioisotopes as tracers are discussed. It is pointed out that these methods are continuously developed and improved, and it is possible to determine indications for the use of various methods and to compare their diagnostic efficacy with roentgenological investigations used for analogous purpose. The advantages of radioisotopic methods are reviewed. It is recommended that scintiscanning is used in clinical practice instead of x-ray examination, primarily in assessment of the efficacy of the treatment carried out or for the purpose of diagnostic observation of the patient. In primary diagnosis of the disease radioisotopic methods of study permit proper choice of special roentgenological methods. (auth)

16105 EVALUATION OF ISOTOPIC CALCIUM ABSORPTION TESTS. Harrison, J. E.; McNeill, K. G.; Wilson, D. R.; Oreopoulos, D. G.; Krondl, A.; Finlay, J. M. (Toronto General Hospital). Clin. Biochem.; 6: 237-245(Dec 1973).

Tests of calcium absorption using radioisotopes are subject to a number of pitfalls which give unreliability and which then produce lack of confidence in the isotopic methods. Tests were carried out on 99 subjects. We show that reliable and clinically significant data can be obtained using either the "double isotope" method or a method based on whole-body retention plus urine excretion. Data based on fecal collections must be regarded with suspicion unless fecal markers such as ^{51}Cr are used. Peak serum activities correlate with true absorption, but as the peak depends not only on absorption but also on other metabolic factors, values for any individual are not reliable. Depending on the type of carrier, tracer calcium absorptions vary even with the same amount of elemental calcium (100 mg). Compared with normal volunteers, patients with renal failure give normal absorptions with calcium chloride as carrier, but low absorptions with milk as carrier. Thus, depending on the type of carrier, different interpretations may be made. By use of the preferred isotopic tests (and using milk as carrier), significant differences in mean absorption were found for renal failure (17 ± S.D. 8), steatorrhea (12 ± 6) and idiopathic hypercalciuria (48 ± 11) compared to controls (28 ± 8). (auth)

16106 NEW RADIOACTIVE ASSAY FOR ENZYMES WITH ELASTOLYTIC ACTIVITY USING REDUCED TRITIATED ELASTIN. The Effect of Sodium Dodecyl Sulfate on Elastolysis. Takahashi, S.; Seifter, S.; Yang, F. C. (Yeshiva Univ., Bronx, NY). Biochim. Biophys. Acta; 327: 138-145(15 Nov 1973).

A method is described for the assay of elastolytic activity based on the use of an insoluble elastin substrate the aldehydes and cross-links of which have been labeled by reduction with tritiated $NaBH_4$. The rate of appearance of radioactivity in the soluble phase of a digest appears to be a more sensitive and better index of elastolysis than both the rates of appearance of materials that react with ninhydrin or with the biuret–Folin reagent. Experiments were also performed to determine whether the reported enhancement of elastolysis occasioned by pretreatment of the substrate with sodium dodecyl sulfate could be verified using the radioactivity assay. Indeed the rate of elastolysis was approximately doubled when the labeled substrate was first treated with sodium dodecyl sulfate. Comparison of the rates of liberation to the soluble phase of radioactivity, ninhydrin-reacting material and of peptides reacting with the biuret–Folin reagent permits an inference that sodium dodecyl sulfate, in addition to inducing formation of new regions of α helix, may expose the polypeptide regions surrounding the cross-links allowing elastase subsequently to cleave these regions more rapidly. (auth)

16107 REGIONAL DISTRIBUTION OF RNA AND PROTEIN RADIOACTIVITY IN THE RAT BRAIN AFTER INTRAVENTRICULAR APPLICATION OF LABELED PRECURSORS. Popov, N.; Pohle, W.; Loessner, B.; Schulzeck, S.; Schmidt, S.; Ott, T.; Matthies, H. (Medizinische Akademie, Magdeburg, Ger.). Acta Biol. Med. Ger.; 31: 51-62(1973).

Results are presented of comprehensive studies on the methodical basis enabling the RNA and protein synthesis to be investigated for varying functional performance of the rat brain, comprising: a reproducible dissection technique to obtain 15 rat brain regions for subsequent biochemical studies; conditions for total RNA labelling after intraventricular application of ^{14}C-orotic acid and tRNA and rRNA labelling after intraventricular injection of ^{3}H-UMP within different brain regions; differences in incorporation between L–1–^{14}C-leucine and L-4,5-^{3}H-leucine into protein precipitates obtained from different brain regions, after intraventricular injection of these precursors; differences in incorporation between water-soluble, triton-soluble, and residual proteins after intraventricular injection of L-4,5-^{3}H-leucine; and the time course of labelling within different protein fractions obtained from hippocampus and separated using polyacrylamidegel electrophoresis. (auth)

16108 STABLE ISOTOPES (ICONS) RESEARCH AND DEVELOPMENT PROGRAM AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Matwiyoff, N. A.; Reisfeld, M. J.; Mills, T. R.; McInteer, B. B.; Goldblatt, M. (Los Alamos Scientific Lab., NM). pp 11-23 of Isotope and Radiation Techniques in Soil Physics and Irrigation Studies 1973. Vienna; International Atomic Energy Agency (1974).

From symposium on isotopes and radiation techniques in studies of soil physics, irrigation and drainage in relation to crop production; Vienna, Austria (1 Oct 1973). See STI/PUB-349; CONF-731010-.

The stable, naturally occurring isotopes of carbon (^{12}C, ^{13}C), oxygen (^{16}O, ^{17}O, ^{18}O) and nitrogen (^{14}N, ^{15}N) [the ICONS], separated in large quantities at the Los Alamos Scientific Laboratory, have added new dimensions to tracing experiments in medical, biological and agricultural studies because: no radiation hazard accompanies their use; and their special nuclear properties allow a direct assay not only of isotopic content but also the location of the isotope in a molecule or complex mixture with mass spectrometric and nuclear magnetic resonance techniques. Although great strides are being made in the application of stable isotopes in biological and medical research, their greatest use should be in agronomy and clinical medicine. Fertilizers labelled with LASL nitrogen-14 and nitrogen-15 are being used in small-scale field studies of the optimum use of nitrogen and of the origin of nitrate contamination of the water table. Compounds labelled with LASL carbon-13 are also being used in the study of metabolic disorders in man and for the development of mass screening tests for metabolic disorders. (auth)

16109 ^{85}Sr METABOLISM IN THE HIP JOINTS OF RABBITS WITH EXPERIMENTAL "PERTHES-LIKE" DISEASE. Axer, A.; Czerniak, P.; Helperin, N.; Gershuni-Gordon, D. H.; Doron, D. (Chaim Sheba Medical Center, Tel-Hashomer, Israel). Israel J. Med. Sci.; 10: No. 3, 230-235(Mar 1974).

Uptake of ^{85}Sr in the proximal femoral epiphysis of young rabbits was decreased when compared to the opposite normal hip joint three and fourteen days after surgically induced ischemia. There was also a consistent increase in radioactivity in the operated acetabulum. These findings were attributed to the slowing or cessation of ossification in the femoral head due to impairment of blood supply to the capital epiphysis, while postsurgical synovitis stimulated the ossification process in the acetabulum. This was further confirmed by surgically induced talcum-synovitis which caused an increase in radioactivity in the femoral head as well as in the acetabulum on the diseased side. The results may indicate that the deformity of the acetabulum in Perthes disease, generally recognized as secondary to femoral head deformity, may in fact develop in the initial stages of the disease. (auth)

16110 RADIOIMMUNOASSAY OF SEX STEROID HORMONES. IV. Radioimmunoassay of Testosterone. Makino, T. (Teikoku Zooki Research Inst., Japan); Inatomi, K.; Yoshida, T.; Den, K.; Takagi, S. Horumon To Rinsho; 21: No. 8, 867-873(Aug 1973). (In Japanese).

Radioimmunoassay (RIA) of testosterone (T) in blood and its problems are described. RIA of T was made after T-3-(O-carboxymethyl) oxime-BSA was synthesized from T, was immunized in rabbit and anti-T serum was made. T, which was separated from extractant of plasma with ether by Sephadex LH-20 microcolumn and was purified, was divided into bound type and nonbound type by salting out of ammonium sulfate, after treatment with anti-T serum. T was labeled with tritium, and RIA of T was made. The concentration of T was calculated by making a standard curve. Standard deviation of bound rate was ± 0.7 to ± 3.2 and its coefficient of variation was 1.1 to 5.7%. Sensitivity was 5 pg. Measurement values were calculated after purified T was added to 0.1 ml of adult female plasma and the whole operations of this measurement method were performed. Accuracy of this method was also discussed. Main steroids were added to plasma and cross reaction was investigated and the effects on measurement of T were examined. RIA and CPBA (competitive protein binding assay) were compared. As a result, measurement values by RIA showed lower values. Concentration of bound T in peripheral blood by RIA was 5.01 ± 1.98 ng/ml in normal adult male and 0.49 ± 0.21 ng/ml in normal adult female. (JA)

16111 SPECIFIC RADIOIMMUNOASSAY ALLOWING SIMULTANEOUS DETECTION OF ANTIBODIES TO SOLUBLE NUCLEOPROTEIN (NPs) AND NATIVE DESOXYRIBONUCLEIC ACID (ADN-N). Robitaille, P. Union Med. Can.; 103: No. 4, 691-698(Apr 1974). (In French).

A very sensitive and specific radioimmunoassay allowing simultaneous detection of antibodies to soluble nucleoprotein (NPs) and native deoxyribonucleic acid (DNA-N) is described. Sera from patients with various connective tissue disorders were screened by this method and the presence of antibodies was shown to be highly diagnostic for systemic lupus erythematosus (SLE). Serial studies on SLE patients showed that the presence of antibodies to NPs and/or DNA-N paralleled renal disease activity as reflected by the degree of proteinuria. The observation of such a phenomenon suggests that antibodies to NPs might be implicated in the pathogenesis of SLE nephritis. (auth)

16112 RADIOIMMUNOASSAY OF THYROXINE (T4) IN SERUM. Bellabarba, D.; Dallaire-Marceau, M.; Tremblay, R. (Univ. of Sherbrooke, Quebec). Union Med. Can.; 103: No. 4, 647-653(Apr 1974). (In French).

A radioimmunoassay method is described for the measurement of thyroxine (T4) in unextracted serum. The mean features of this assay are the following: T4 antibodies are obtained by immunization of rabbits with repeated injections of a T4-human serum albumin conjugate; a barbital buffer containing 8-anilino-1-naphtalene sulfonic acid (ANS) is used to block T4 binding to thyroxine binding proteins; and precipitation by polyethylene glycol (Carbowax 6000) is used to separate free from antibody bound hormone. This step represents the major modification in comparison to other similar techniques. (auth)

16113 RADIOIZOTOPNOE SKENNIROGANIE, UL'TRAZVUKOVAYA BIOLOKATSIYA I TEPLOVIDENIE V KLINIKE. (Radioisotopic Scanning, Ultrasonic Biolocation, and Heat Sensing in the Clinic). Makarenko, T. P.; Bogin, Yu. N.; Upyrev, A. V.; Bogdanov, A. V. Moscow; Meditsina (1973). 240p.

Problems in clinical use of radioisotope scanning, ultrasonic biolocation, and heat sensing in the diagnosis of diseases of the thyroid gland, tumors of the uterine cervix, the different pathologies of the organs of the chest cavity, of the intestinal cavity, and of other organs and systems are discussed. Sources of error in the diagnostic use of radioisotopes for scanning, in echography, and in heat-sensing are considered. Special attention is given to the significance of these methods in complex clinical examinations and the use of the data obtained for indicating the need for puncture biopsies, splenoportography, laparoscopy, pleural punctures, and pericardial punctures. The monograph is designed for the use of doctors in different specialties who use radioisotopic scanning, echography, and heat sensing in their practice. (tr-auth)

16114 RADIOISOTOPES IN THE STUDY OF VASCULAR ALTERATIONS. Fossati, F.; Ressi, F. S. (Ospedale Ca' Granda, Milan). Radiol. Med.; 59: No. 11, 1080-1101(Nov 1973). (In Italian).

Results obtained with radioisotope techniques in the diagnosis and localization of vasculopathies and their parenchymal consequences, such as cerebral infarct and arteriovenous aneurysms, pulmonary infarct due to thromboembolism, and cardiac infarct, are reported. (auth)

16115 EFFECT OF ROSE BENGAL PURITY ON THE RAT LIVER FUNCTION TEST. Kubodera, A. (Science Univ. of Tokyo); Tsurufuji, S. Radioisotopes (Tokyo); 22: No. 8, 422-427(Aug 1973). (In Japanese).

The commercially available rose bengal was fractionated into different compounds using Sephadex G-25 column on gelfiltration. Physical properties of each fraction were determined. A fraction that was considered to be composed of the same substances as radiochemical impurities observed by paper-chromatographic analysis of ^{131}I-rose bengal was labeled by radioactive iodine. The effect of these labeled compounds on rose bengal liver uptake test and the distribution of the compounds in rat were investigated. The liver uptake levels of the labeled different compounds reached to the maximum at fifteen minutes after i.v. administration. The maximum liver uptake levels of these compounds were proved to be approximately one-half of the radiochemically pure labeled rose bengal liver uptake. It will be indicated that decrease of radiochemical purity of ^{131}I-rose bengal might cause the decrease of the liver uptake of ^{131}I-rose bengal. A careful attention should be paid on the purification of the raw material during the manufacturing process of ^{131}I-rose bengal, and also confirmation of radiochemical purity should be made when it is used. (auth)

16116 CLINICAL STUDIES ON THYROXINE-BINDING PROTEIN IN HUMAN SERUM. II. In Vitro Uptake of ^{131}I-Labeled Triiodothyrothyronine by Human Red Blood Cells and Resin. Nakaie, K. (Kyoto Univ.). Naika Hokan; 20: No. 8, 235-245 (Aug 1973). (In Japanese).

Uptake of ^{131}I-T_3 by human red blood cells in vitro, ^{131}I-T_3 (triiodothyrothyronine) uptake by resin, and Triosorb resin sponge uptake were studied as to the basic problems and diagnostic value. (JA)

16117 FUNDAMENTAL AND CLINICAL STUDIES OF ^{131}I LABELED FAT AND FATTY ACID ABSORPTION TEST BY ABDOMINAL COUNTING. I. Fundamental Studies of Abdominal Counting. Kaneko, T. (Kumamoto Univ., Japan). Kumamoto Igakkai Zasshi; 47: No. 5, 307-314(Mar 1974). (In Japanese).

Thirty drops of Lugol's solution or three tablets of sodium iodide were administered 3 times daily for 48 hours before the radioactivity tests. After the administration of radioactive capsule test meals, abdominal counting was carried out over the abdomen at hourly intervals during about 8 hours by a gamma camera with a diverging collimator and scintigrams were obtained simultaneously. In order to study the influence of the free radioactive iodine which was contained within the commercial ^{131}I-triolein capsule test meal, five radioactive capsule test

meals, a $Na^{131}I$ capsule, a $Na^{131}I$ solution and nonlabeled triolein mixed capsule, a $Na^{131}I$ solution and nonlabeled oleic acid mixed capsule, a commercial ^{131}I-triolein capsule, and a commercial ^{131}I-oleic acid capsule were administered in the same subject respectively, and it was recognized that free radioactive iodine was absorbed during the first 3 hours after the administration at the latest, and the commercial ^{131}I-oleic acid capsule test meal also easily absorbed in the same duration. (auth)

16118 FUNDAMENTAL AND CLINICAL STUDIES OF ^{131}I LABELED FAT AND FATTY ACID ABSORPTION TEST BY ABDOMINAL COUNTING. II. Clinical Studies of Abdominal Counting. Kaneko, T. (Kumamoto Univ., Japan). Kumamoto Igakkai Zasshi; 47: No. 5, 315-331(Mar 1974). (In Japanese).

Results are reported of abdominal scanning of patients with metabolic diseases involving intestinal fat absorption following the administration of ^{131}I-triolein or ^{131}I-oleic acid. The absorption of the small intestine can be expressed as the following formula: $A = A_0e^{-kt}$, where A_0 is the initial abdominal counts, A is the abdominal counts at the time t, k is the coefficient of absorption, and t is the time after the administration of radioactive reagent. The abdominal counts after the administration of radioactive reagent are plotted against time on a semilogarithmic paper, and then the coefficient of the small intestine (k) is calculated by the method of least squares. In the investigation of the abdominal count curves after the administration of the ^{131}I-triolein capsule test meal, four different types were observed: normal, accelerated gastric emptying, slow absorbing, and delayed absorbing types. A total of 177 cases were studied by the abdominal counting technique which has been previously described and by the determination of the fecal radioactivity (% of dose) simultaneously. In the cases of 115, both the ^{131}I-triolein and ^{131}I-oleic acid absorption tests were carried out and in the 62 cases the ^{131}I-triolein test only. The coefficient of the small intestine (k) was 0.09-0.21 (wean 0.13 ± 0.03) for normal cases, and 0.03-0.08 (mean 0.07 ± 0.01) for chronic pancreatitis. The cases of intrathoracic esophagogastrostomy revealed the decreased value of (k), and also in the cases of radiation therapy the lower value with the increase of the dose of irradiation. From the above, the normal range of the ^{131}I-triolein absorption test by the abdominal counting technique was more than 0.1. The cases in which the value of (k) was less than 0.1, the presence of malabsorption was strongly suspected. There were little differences among the kinds of diseases in the results of the ^{131}I-oleic acid absorption test, and ^{131}I-oleic acid seemed to be unadaptable to the absorption test. (auth)

16119 CLINICAL STUDIES ON CIRCULATORY DYNAMICS BY MEANS OF RADIOISOTOPE DILUTION METHOD. Takayasu, M. (Kyoto Univ.). Nippon Naika Gakkai Zasshi; 62: No. 8, 881-897(Aug 1973). (In Japanese).

Methods for measuring blood in the heart by scintiscanning following the administration of ^{131}I-labeled compounds or ^{133}Xe are discussed. Radiocardiograms of cases of atrial septal defect, ventricular septal defect, and pure aortic insufficiency are discussed and results are compared with data obtained using Fick's method. In the disease groups of mitral stenosis, mitral insufficiency, pericarditis, chronic pulmonary diseases, and cardiac failure due to myocardial disease, cardiac output, circulation volume, the distribution of circulating blood in the cardiac and pulmonary bodies, and left to right gradient of ventricles were observed on the basis of the radiocardiographic data. This method lacks information on blood pressure and does not allow analysis of time-course changes of the heart shape and the atria and ventricles separately. However, it is simple to perform and produces much information on the progress of disease state and the therapeutic effect of treatment when repeated on the same case. (CH)

16120 BIFUNCTIONAL EDTA ANALOGUES WITH APPLICATIONS FOR THE LABELING OF BIOLOGICAL MOLECULES. Sundberg, M. W. Stanford, CA; Stanford University (1973). 224p. University Microfilms Order No. 74-6559.

Thesis (Ph. D.).

Use of perturbed angular correlations (PAC) to the study of biologically interesting problems is considered. The PAC technique is based on two observations: (1) there can be an angular correlation in the directions of emission of two gamma rays when they are emitted successively from a radioactive nucleus, and (2) this angular correlation may be perturbed by interaction of nuclear moments of the intermediate state with fluctuating external fields. The sensitivity and in vivo applicability of a radioactive source together with motional information provided by PAC make it a potentially useful technique for the study of biological systems. Among the metals that emit coincident gamma rays, indium-111 appears to be particularly convenient for studies involving biochemical systems. The diazonium salt has been used to attach indium-111 ions to bovine fibrinogen and human serum albumin. When the labeled proteins are injected into the tail vein of mice carrying a transplanted tumor, the radioactive label concentrates in the malignant tissue. Observation of the biological lifetimes of the labeled proteins indicate they are consistent with previous work. The technique represents an extension of general radioactive tagging, and provides a means of preparing qualitatively new radiopharmaceuticals which allow nearly any protein to be tagged with any metal chelated strongly by EDTA. When the indium-111-chelate of 1-(p-nitrophenyl)-ethylenediamine-N,N,N',N'-tetraacetic acid is added to a solution of rabbit antiserum to dinitrophenyl groups the angular correlation of the coincident gamma rays is strongly perturbed, indicating that the molecule is bound by the antibody. The binding constant for the reaction has been determined from PAC measurements illustrating the ability of PAC to provide quantitative information concerning weak interactions using small samples of dilute, unpurified body fluids. When the indium-111-chelate of 2,4-dinitro-3'-[p-(ethylenediamine-N,N,N',N'-tetraacetic acid)-azophenyl]-4'-hydroxydiphenylamine is injected in mice the perturbation in the angular correlation increases over a period of several hours. These experiments indicate that PAC in conjunction with a metal-chelating label may be used to observe changes as they occur in mammalian systems, and potentially may provide information previously unobtainable by any technique. (Diss. Abstr. Int., B)

16121 THYROTROPIN RELEASING HORMONE (TRH): DISTRIBUTION IN THE BRAIN, BLOOD, AND URINE OF THE RAT. Jackson, I. M. D.; Reichlin, S. (Tufts-New England Medical Center, Boston). Life Sci.; 14: No. 11, 2259-2266(1 Jun 1974).

Measurement of thyrotropin releasing hormone (TRH) in the rat by a radioimmunoassay (using ^{125}I) capable of detecting 6 pg is described. TRH was found in high concentration in the hypothalamus, especially in the stalk median eminence (SME). Small but significant concentrations were also detected throughout the extrahypothalamic brain. Quantitatively, these levels are substantial, and suggest that this tripeptide may have an extrathyroidal brain function. TRH was measureable in the blood only in low concentrations, but large amounts were excreted in the urine (18.4 ng/day). (auth)

16122 NEW HORIZONS IN NUCLEAR MEDICINE. Lenihan, J. M. A. (Western Regional Hospital Board, Glasgow). pp 327-338 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Developments in the field of nuclear medicine are reviewed and new applications of radionuclide tracers for medical studies are suggested. (CH)

16123 ISOTOPIC SPLENOPORTOGRAPHY. Morphological and Kinetic Results. Paraf, A. (Hopital Franco-Musulman, Bobigny, France); Vinot, J. M.; Syrota, A.; Roucayrol, J. C. Sem. Hop. Paris; 50: No. 3, 237-242(14 Jan 1974). (In French).

The intrasplenic injection of 10 millicuries of ^{99}Tc-labeled albumin in a volume of less than 2ml enabled images to be obtained of the splenoportal trunk, the vascularization of the liver, and the cardiac cavities. The hepatic and cardiac delay times can be easily measured. The quality of the morphological aspects revealed by the isotopic method is inferior to that of radiological images. The technique used, however, does not involve risks and provides supplementary information: the hepatic and cardiac delay times are more sensitive criteria for the existence of diversions than the presence of varices, which are not always visible, even when splenoportography is used. (FR)

16124 DYNAMIC CEREBRAL STUDIES WITH THE SCINTILLATION CAMERA. Problems Associated With Differential Diagnosis and Quantitative Investigations. Itti, R. (Centre Hospitalier Regional Bretonneau, Tours, France); Planiol, T.; Plagne, R.; Lafaye, C. J. Biol. Med. Nucl.; 8: No. 34, 16-32(1973). (In French).

Gamma-encephalographic techniques are being used increasingly because of the fact that a single atraumatic examination can provide simultaneously a bilateral visual display of the injection phase of the main cerebral vessels (even when it is very imperfect), measurement of transit times in different regions, and observations of the diffusion of the tracer into the lesion. Nevertheless in the field of differential diagnosis many difficulties remain. These difficulties are related principally to angioblastic and reduced circulation aspects. Quantitative studies of the parameters of the first circulation of the embolus together with mathematical models describing the pathological modifications occurring in the transit curves yield supplementary information. Such information suggests sources of uncertainty and is an absolutely essential complement to the purely qualitative studies undertaken. (FR)

16125 EXPLORATION USING LABELED BLEOMYCIN IN THE DIAGNOSIS OF SKIN SPITHELIOMAS, MALIGNANT MELANOMAS, AND THEIR METASTASES. Moret, R. (Univ., Lyon); Ortonne, J. P.; Perrot, H.; Thivolet, J. Nouv. Presse Med.; 3: No. 4, 193-195(26 Jan 1974). (In French).

An experiment is described in which cobalt-57-labeled bleomycin was used to diagnose 18 skin carcinomas or melanomas and their metastases. Emphasis is given to the variations in the uptake of this complex by the tumor cells. The usefulness of this type of examination remains to be confirmed. (FR)

16126 CLINICAL APPLICATION OF A NEW BIOPHYSICAL METHOD BASED ON THE ISOTOPIC ANALYSIS OF CO_2 EXHALED BY MAN. Duchesne, J.; Mosora, F.; Lacroix, M.; Lefebvre, P.; Luycks, A.; Lopez-Habib, G. (Univ., Liege). Compt. Rend., Ser. D; 277: No. 20, 2261-2264(19 Nov 1973). (In French).

A process for analyzing diabetes in man was developed from a general method elaborated by Duchesne, et al., based on studies of the $^{13}C/^{12}C$ isotope ratio of exhaled CO_2. It is concluded that this first application of the method is a preliminary stage in the development of numerous applications in the field of pathology. (FR)

16127 STUDY OF REGIONAL PULMONARY VENTILATION BY INHALED XENON-133 IN CHILDREN AND INFANTS. Scintigraphic Results. Gaultier, C. (Hopital Trousseau, Paris); Gerbeaux, J.; Mensch, B. Ann. Pediat. (Paris); 50: No. 4, 325-332(2 Apr 1974). (In French).

The regional exploration of pulmonary ventilation was carried out by studying the distribution and excretion of inhaled xenon-133 by a rebreathing method. This study is applicable at any age, both in new-born and in older children. The indications for regional investigation are local disorders of ventilation. The results of this study permit physiopathological analysis of an abnormal radiological image, such as hyperluscent lung or opacity, determine the topography of the lesions, and thus guide endoscopy. Finally, the regional functional results complete and explain results of overall methods of exploration of pulmonary functions (spirography, ventilatory mechanics, hyperoxia test) of transthoraco-electrical measurements and study of pulmonary perfusion by Tc-99m. Non-traumatic, without danger, this regional study of pulmonary ventilation may be repeated to follow the course of the disease. (FR)

MATERIALS

16128 MAGNETISM AND MAGNETIC MATERIALS, 1973. Part 1. 19th Annual American Institute of Physics Conference, Boston, Massachusetts, November 16–18, 1973. Graham, C. D. Jr.; Rhyne, J. J. (Eds.). AIP Conference Proceedings, Number 18, Part 1. New York; American Institute of Physics (1974). 748p. (CONF-731104-P1).

Approximately 146 papers presented at the conference are included in Part 1. A separate abstract was prepared for twenty-nine papers selected as in-scope for NSA. One paper was previously abstracted in NSA as 29: 05395. (JRD)

For abstracts of individual papers see: 16208–16220, 16356–16370, and 16443.

16129 (EUR-5119) BIBLIOGRAPHY ON HEAT TRANSPORT IN NUCLEAR FUELS AND RELATED PHENOMENA. Richter, J.; Schmidt, H. E.; Tasman, H. A. (Commission of the European Communities, Karlsruhe (F. R. Germany). European Inst. for Transuranium Elements). Mar 1974. 217p. Dep. NTIS (US Sales Only) $14.00 EUR B.Fr. 300.

This bibliography contains 3915 references on heat transport in nuclear fuel materials and related phenomena, covering theoretical and experimental work, papers on modeling, data collections, and review articles. The latest updating took place in September 1973, with the earliest reference dating from 1883. Each reference is provided with a set of key symbols which designates the contents of the article for selective retrieval. The keyword system is tailored to fit the particular needs of a laboratory engaged in physical property work on nuclear fuel materials. (DLC)

16130 FAILURE MODES IN COMPOSITES. Proceedings of the Symposium Held in Boston, Massachusetts, May 8–11, 1972. Toth, I. (ed.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973). 475p. (CONF-720514-).

Twenty papers were presented at the symposium. One paper was previously abstracted in NSA as 29: 10737. Separate abstracts were prepared for ten papers. The remaining papers were not in the scope of NSA. (JRD)

For abstracts of individual papers see: 16148–16154, 16320, 16321, and 16462.

16131 NEW INDUSTRIES AND APPLICATIONS FOR ADVANCED MATERIALS TECHNOLOGY. 19th National SAMPE Symposium and Exhibition, Buena Park, California, April 23–25, 1974. 19th National SAMPE Symposium and Exhibition, Volume 19. Azusa, CA; Society for Advancement of Material and Process Engineering (1974). 774p. (CONF-740437-). $30.65.

Approximately 130 papers were presented at the symposium. A separate abstract was prepared for each of five papers selected by NSA scope. Papers for which no abstracts were prepared are concerned with adhesives composites, metals, evaluation of materials, ablatives, and electrical components. (JRD)

For abstracts of individual papers see: 16147, 16260, 16261, 16318, and 16319.

16132 COMPARISON OF IN-PILE COMPATIBILITY BEHAVIOR OF OXIDE AND CARBIDE FUEL PINS ACCORDING TO SIMULATION TESTS. Goetzmann, O.; Hofmann, P. (Kernforschungszentrum Karlsruhe, Germany). pp 233-245 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

The compatibility behavior of oxide and carbide fuels with a stainless steel cladding is discussed on the basis of results obtained so far. To evaluate the difference in compatibility behavior of these two types of reactor fuel under reactor conditions, a series of out-of-pile experiments was carried out, adding various fission-product elements to the fuels to simulate the chemical state after a period of irradiation. From the results, the conclusion can be drawn that fission products play no role in the compatibility behavior of carbide fuels whereas the compatibility behavior of an oxide fuel is decisively influenced by fission products. It is to be expected that the only interaction between a carbide fuel and the cladding is the carburization of the cladding material. This carburization leads to a reduction in ductility of the stainless steel cladding which can be tested out of pile. (8 figures) (auth)

16133 STUDY OF REACTIONS BETWEEN (U, Pu)O_2 FUEL AND SODIUM. Housseau, M.; Marin, J. F.; Anselin, M. F.; Dean, G. (CEN, Fontenay-aux-Roses, France). pp 277-291 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

Results are presented of out-of-pile studies on the reaction between sodium and mixed oxides (U, Pu)O_2. The various parameters (temperature, time, mixed-oxide composition, presence of fission products, sodium purity, mechanical interaction with the can) were varied with a view to establishing their role in the occurrence and progress of the reaction, and also the nature and some of the properties of the products formed. Observations were carried out during a cladding failure which occurred in the Rapsodie-Fortissimo reactor, and the effect of the failure on the behavior of the fuel and the migration of its constituents and the fission products is discussed. (10 figures) (auth)

16134 SUPERALLOYS, SPECIAL-DUTY METALS; NONMETALLICS; PLASTICS INCLUDING PARTS, SHAPES, AND COMPONENTS. Metal Progr.; 106: No. 1, 121-145(Jun 1974).

Chemical composition, mechanical and other properties, and applications are tabulated for the following materials: Ni-base alloys, Fe–Ni-base alloys, Co-base alloys, cryogenic and low-temperature alloys, noble metals, high-alumina ceramics (thermal and electrical properties also given), refractory metal alloys, and engineering plastics. (DLC)

Ceramics and Cermets

Refer also to abstracts 14886, 14887, 15084, 15085, 16259, 17471, 17580, 17642, 17663, 17683, 17722, 17955, and 17957.

16135 (CEA-N-1684) PREPARATION OF SUBSTOICHIOMETRIC TITANIUM CARBIDES AND MIXED TITANIUM–TANTALUM CARBIDES. Rossignol, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Jan 1974. 62p. (In French). Dep. NTIS (US Sales Only) $6.25.

Thesis. Submitted to Paris Univ., Orsay, France.

A method is presented for the preparation of titanium carbides suitable for fabricating pure samples having a wide range of carbon substoichiometry, powder metallurgy and natural sintering techniques being used. The carbon/titanium hydride powder mixture is compacted and then heated under vacuum to 1500°C (temperature at which a solid state reaction of carbon on titanium occurs). The products obtained are then subjected to a homogenizing-sintering-treatment. This process takes place in a secondary vacuum and at temperatures corresponding to the requirements of the different carbon contents of the samples. The compositions obtained are the bases for new curves to be plotted for the variations of the carbide unit cell parameter as a function of the carbon contents. The substoichiometry range is limited to 100 titanium atoms per 48 carbon atoms ($TiC_{0.48}$) because beyond this value, the fcc structure ceases to exist. The method was modified to treat mixed titanium/tantalum carbides, a homogenizing–sintering furnace being constructed to treat samples under vacuum up to a temperature of 2600°C. Some samples were prepared. (FR)

16136 (CONF-740622-7) ANALYSIS OF THE SAFEGUARDS STATUS OF FUEL REPROCESSING PLANTS. Brown, R. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs–Operations Office). 1974. 11p. Dep. NTIS $4.00.

From meeting of institute of nuclear materials management; Atlanta, Georgia, USA (19 Jun 1974).

A simple method has been developed for the analysis of the safeguards status of fuel reprocessing plants and for the evaluation of various strategies for meeting inventory requirements for special nuclear materials (SNM). Vessel-by-vessel estimates of SNM inventory are made for a complete reprocessing system, from fuel elements through final product UO_3. The inventory in each material balance area is divided into two categories, that which may be directly measured and that which must be estimated. A parametric study of the maximum allowable estimate error was conducted for a range of conditions that are typical of the Idaho Chemical Processing Plant. The analysis provided a unified basis for the evaluation of process design, process operation, analytical accuracy, and indirect measurement needs and their relationship to proposed SNM inventory standards. (auth)

16137 (EURFNR-1145) CREEP AND RECOVERY PHENOMENA IN URANIUM/PLUTONIUM MIXED OXIDE. Vollath, D.

(Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Nov 1973. 134p. Dep. NTIS $5.45.

Work performed under United States–Euratom fast reactor exchange program.

Creep experiments on uranium–plutonium mixed oxide are described. Besides the stress and temperature dependency of the steady state creep a phenomenological explanation of the transient creep behavior is also given. For slightly hypostoichiometric uranium–plutonium dioxide a two-term creep formula is determined. In this formula, the two stress exponents are 1 and 4.5. To these stress exponents, activation energy values of 117 and 175 kcal/mol are adjoined. With the aid of recovery measurements it is possible to adjoin to these two terms in the creep formula mechanisms of grain boundary creep and dislocation climbing. On the basis of the recovery measurements the activation energy of movement of oxygen and uranium ions in uranium dioxide of different stoichiometry is also evaluated. (44 fig., 14 tables, 67 references) (auth)

16138 (FRNC-TH-462) VOLTERA'S EQUATION FOR THE STATISTICAL THEORY OF FRENCKEL PAIR CREATION IN A SOLID SUBJECTED TO NEUTRON IRRADIATION. Chamayou, J. M. F. (Toulouse-3 Univ., 31 (France)). 1973. 143p. (In French). Dep. NTIS (US Sales Only) $10.25.

Thesis.

A statistical theory is presented for the creation of Frenkel ion pairs in a solid subjected to neutron irradiation. The mathematical model adopted belongs to a very large class of cascade processes utilized for electron-hole pair production in semiconductors. Very general hypotheses are made. No particular type of atomic collisions are envisaged, the atomic cross sections representing only some general regularity trends. The asymptotic behavior of the solution of Volterra's functional integral equation is deduced as well as the unity, continuity, compatibility, and consistence of the solution to the equation of the model for the cross sections. In this way, it is possible to determine the mean number of atoms displaced per incident primary atom in a solid subjected to neutron irradiation. The nature of the law concerning the number of displacements was determined from studies of the first cumulants. The law is Gaussian for weakly anisotropic collisions and Poissonian for strongly anisotropic collisions. The numerical method enables an approximation to be obtained for the solution of the integral equation using spline functions. Applications are presented which demonstrate the role of the displacement energy in the KINCHIN and PEASE, and SNYDER models as well as the importance of the first coefficients of the expansions for a cross section using LEGENDRE polynomials for the low energy primaries. The results of these calculations can be used for semiconductors and in particular for PN silicon junctions exposed to fast neutrons. In this way, the fluence rate can be related to the lifetimes of the minority carriers with a relation which is no longer deterministic but random. (FR)

16139 (GERHTR-86) PYROCARBON AND ITS APPLICATION TO REACTOR TECHNOLOGY. Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen). 1974. 31p. (CONF-740103-4). Dep. NTIS (US Sales Only) $4.75.

From conference on structure-property relationships in thick film and bulk coatings; San Francisco, California, USA (28 Jan 1974).

Work performed under United States–German High Temperature Reactor Research Exchange Program.

A survey of deposition methods for pyrocarbons is given, especially the fluidized bed process for nuclear fuel kernel coating. Structures of pyrocarbons are dependent on such parameters as deposition temperature, nature and pressure of the pyrolysis gas, substrate, geometry of the deposition system, etc. In the fluidized bed process, it is possible to deposit isotropic pyrocarbon layers which are much more resistant to fast neutron irradiation than anisotropic pyrocarbon coatings. The determination of apparent density, BACON-anisotropy-factor, and apparent crystallite size is not sufficient to characterize this material, and efforts have been made to develop new methods. The new physical procedures are the determination of the optical anisottopy factor, measurement of the microporosity distribution, and transmission and scanning electron-microscopy. New chemical methods are plasma- and wet-oxidation processes. With examples, the behavior of pyrocarbon coatings under irradiation with fast neutrons as well as the formation and deposition mechanisms of pyrocarbons are also discussed. (13 figures, 27 references) (DLC)

16140 (INIS-mf-970) RECENT DEVELOPMENTS IN THE FUEL PELLETS FABRICATION PROCESS. Barberis, P.; Liscia, A.; Sberze, L. (Comitato Nazionale per l'Energia Nucleare, Saluggia (Italy)). Oct 1972. 10p. INIS.

From 2nd Italian–Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

Most power reactors use ceramic fuel elements which generally require cylinders of uranium dioxide. The procedure normally used for UO_2 pellet production on an industrial scale for many years has been rather complicated with many steps: powder milling, blending with binder, granulating, bending with lubricant, drying, pressing, presintering, sintering. Also in CNEN this procedure was adopted at the start. Manufacture of UO_2 pellets over a ten-year period has allowed to perfect a simple and economic method for the production of UO_2 pellets, the success of which necessitates a strict and continuous control of powder characteristics. (auth)

16141 (N-73-32531) FISSION GAS RELEASE CORRELATION FOR URANIUM NITRIDE FUEL PINS. Weinstein, M. B.; Davison, H. W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Oct 1973. 57p. (NASA-TN-D-7401; E-7498). NTIS $3.50.

A model was developed to predict fission gas releases from UN fuel pins clad with various materials. The model was correlated with total release data obtained by different experimentors, over a range of fuel temperatures primarily between 1250 and 1660°K, and fuel burnups up to 4.6%. In the model, fission gas is transported by diffusion mechanisms to the grain boundaries where the volume grows and eventually interconnects with the outside surface of the fuel. The within grain diffusion coefficients are found from fission gas release rate data obtained using a sweep gas facility. (auth)

16142 (N-74-10543) PREPARATION OF REFRACTORY CERMET STRUCTURES FOR LITHIUM COMPATIBILITY TESTING. Heestand, R. L.; Jones, R. A.; Wright, T. R.; Kizer, D. E. (Battelle Columbus Labs., Ohio (USA)). Feb 1973. Contract NAS3-13465. 48p. (NASA-CR-121130; BMI-762-11). NTIS $4.50.

High-purity nitride and carbide cermets were synthesized for compatability testing in liquid lithium. A process was developed for the preparation of high-purity hafnium nitride powder, which was subsequently blended with tungsten powder or tantalum nitride and tungsten powders and fabricated into 3-in. billets by uniaxial hot pressing. Specimens were then cut from the billets for compatability testing. Similar processing techniques were applied to produce hafnium carbide and zirconium carbide cermets for use in the testing program. All billets produced were characterized with respect to chemistry, structure, density, and strength properties. (auth)

16143 (SGAE-2216) DIFFUSION OF URANIUM AND THORIUM IN PYROCARBON. Koss, P.; Balthesen, E.; Nickel, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Forschungszentrum). Dec 1973. 10p. (CONF-730601-8). Dep. NTIS (US Sales Only) $4.00.

From 11th Biennial conference on carbon; Gatlinburg, Tennessee, USA (4 Jun 1973).

A systematic survey of the structure dependence of uranium and thorium diffusion in pyrocarbon was performed. Crystallite size, anisotropy, density, and the hydrocarbon used have shown to be controlling parameters for the chemical potential and the diffusion coefficients. A dependence on the source of the diffusion element e.g. oxide or carbide was observed. (auth)

16144 (STI/PUB-346(Vol.2)) FUEL AND FUEL ELEMENTS FOR FAST REACTORS. Volume II. Conference Held at Brussels, Belgium, July 2–6, 1973. Proceedings Series. (International Atomic Energy Agency, Vienna (Austria)). Apr 1974. 508p. (In several languages). (CONF-730726-P2). IAEA $22.00.

Fifty-two papers presented at the symposium are included in volume II. A separate abstract was prepared for twenty-six papers selected by NSA scope. (JRD)

For abstracts of individual papers see: 16190–16203, 16266, 16267, 16350–16353, and 16437–16442.

16145 MODERATION CONTROL FOR PROCESSING MIXED-OXIDE FUELS. Ernst, B. (Nuclear Materials Equipment Corp., Apollo, PA). Trans. Amer. Nucl. Soc.; 18: 167-168(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16146 FORMATION OF NIOBIUM CARBIDE BY THE CARBONIZATION OF Nb_2O_5 IN AN ARGON PLASMA ARC. Matsumoto, O.; Saito, M. (Aoyama Gakuin Univ., Tokyo). High Temp. Sci.; 6: No. 2, 135-141(Jun 1974).

In the carbonization, a metallic cake was formed on the anode. X-ray diffraction patterns and chemical analysis showed that the cake was nearly stoichiometric NbC. The overall reaction appears to be $Nb_2O_5 + 7\ C = 2\ NbC + 5\ CO$. The molar ratio of graphite to

Nb_2O_5, current, and reaction time considerably affected the reaction. The measured value of the density was 7.81 g/cm³ for the stoichiometric NbC, in agreement with the x-ray density. The products were found to be superconducting and the transition temperature varied with composition. The highest transition temperature was reached for the stoichiometric NbC and was 11.3°K. (7 fig) (auth)

16147 LOW-COST METHODS FOR FABRICATION OF ALUMINUM–BORON SHAPES. Divecho, A. P. (Commonwealth Scientific Corp., Alexandria, VA); Lalaccona, F. pp 379-390 of New Industries and Applications for Advanced Materials Technology. Azusa, CA; Society for Advancement of Material and Process Engineering (1974).

From new industries and applications for advanced materials technology symposium; Buena Park, California, USA (23 Apr 1974). See CONF-740437-.

Deformation processing has not been seriously considered as applicable to composite fabrication, particularly if the filament (e.g., boron) lacks plasticity. When, however, the brittle filament is clad with a ductile matrix such as 6061 Al, the underlying filament is protected from damage even when cold worked severely as in drawing and rolling. These two metal-working processes have been applied to produce seven ply aluminum 50 vol % boron tubes up to 2" OD by 3 feet in length and flats 1" in width by 2 feet in length respectively. Although adequate densification is achieved via drawing and rolling, the former has been given major emphasis. Mechanical properties of rolled and drawn flats and tubes compare favorably with those prepared by static methods. However, the objective of the presentation is to focus on lower processing costs. In specific terms, 2" tubes in lengths up to 12 feet can be produced for as little as $150/lb. This is possible only because standard drawbench and carbide dies can be utilized. Furthermore, the major steps including cladding, preform preparation and drawing are conducive to automation and, therefore, preclude the requirement for skilled labor. Most important, the processing sequence is sufficiently versatile to permit fabrication of a wide variety of composite systems including 4, 5.6, and 8 mil filaments of boron Borsic, SiC, beryllium, or sapphire with wrought aluminum, titanium, or nickel alloys without major modifications. These aspects are considered along with metallography of composite tube structures and mechanical property data. (auth)

16148 ELONGATION AND FRACTURE OF METAL/METAL COMPOSITES. Davis, A.; Scala, E. (Cornell Univ., Ithaca, NY). pp 81-101 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

The large tensile strain characteristics and the fracture mode of reinforced brass composites were found to be dependent on both fiber volume fraction and fiber properties. Three types of reinforcement were studied: wires with limited ductility, i.e., a plastic tensile strain to failure much less than that of the matrix, (tungsten and high carbon steel); wires with extensive ductility having failure strains approximately equal to that of the matrix (molybdenum and low carbon steel); and brittle wires (embrittled platinum and tantalum). Composites made with limited ductility wires had fracture strains that increased with decreasing wire volume fractions so that at low levels of reinforcement the composite fracture strain was higher than the wire fracture strain with no evidence of premature wire failure. Composites made with the highly ductile wires had failure strains which were independent of volume fraction and tensile strengths that increased linearly with wire volume fraction, following the rule of mixtures. Composites made with the brittle wires had stress-strain curves that were continuously serrated from 0.3% strain to failure. A mechanism is suggested to account for the dependence of strain to fracture on fiber volume fraction and the occurrence of composite strains greater than the conventional wire fracture strain. (auth)

16149 PROPERTIES AND FRACTURE MODES OF BORSIC–TITANIUM. Collins, B. R.; Brentnall, W. D.; Toth, I. J. (Air Force Materials Lab., Wright-Patterson AFB, OH). pp 103-128 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

Borsic/Ti–6Al–4V composites have been fabricated utilizing the full reinforcement potential of the filaments. A fabrication cycle of 30 minutes at 1500°F was found to optimize the longitudinal and transverse room temperature strengths of this system, yielding a critical reaction zone thickness of 8000 Å. Multiple filament breaks were found to occur prior to longitudinal composite failure and hence improvements in the filament strength distribution would suggest improvement in tensile strength. Transverse failure was found to be limited by failure of the interface, filament splitting, and inadequate interlaminar bonding. Improved control of the filament spacing would therefore give rise to improved transverse strengths. The temperature dependence of the longitudinal strength is similar to that of the filaments showing a reduction in in situ filament strength. The transverse tensile strength is nearly independent of temperature indicating a limiting mechanism also relatively independent of temperature. This is shown to be predominantly interface failure with some fiber splitting. The properties and simplicity of the system have been shown to make Borsic/Ti–6Al–4V a potentially superior composite material with a wide range of applications. (auth)

16150 FRACTURE TOUGHNESS OF COMPOSITES. Kreider, K. G.; Dardi, L. (United Aircraft Research Lab., East Hartford, CT). pp 193-230 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

A review is presented of the standard notch toughness evaluation performed primarily on high modulus fiber reinforced composites. One of the goals in this work is to determine if the fracture of these composites can be successfully treated within the framework of existing linear elastic fracture mechanics. Also the studies have involved an assessment of the significance of fracture work, of the mechanisms of fracture, of the effects of the constituent material properties, and specimen geometry on composite behavior. Composite strengths have indicated properties ranging from the standard homogeneous performance where the notch strength is equal to a constant times the inverse square root of the notch length to a behavior in which the net section stress at failure is independent of notch length. (auth)

16151 NOTCHED IMPACT AND FLEXURAL BEHAVIOR OF BORON–ALUMINUM. Dardi, L. E.; Kreider, K. G. (Pratt and Whitney Aircraft, East Hartford, CT). pp 231-270 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

The fracture behavior of BORSIC + aluminum composites has been investigated using Charpy impact tests and slow bend tests of Charpy "V" notch specimens in several orientations and fiber volume fractions. The energy per unit area of longitudinally reinforced material was found to increase with fiber volume percentage. The impact energy of transversely reinforced BORSIC + aluminum is nearly independent of volume fraction fiber and approximately one-third to one-fifth that of longitudinally reinforced material. The energy per unit area of ±45° orientations are intermediate to longitudinally and transversely reinforced materials. Potentially significant mechanisms of energy absorption were discussed and it was found that the impact energy per unit area, G in-lb/in² could be expressed in terms of the fiber diameter, d_f, fiber strength, σ_f, volume fraction fiber, v_f, and matrix shear yield strength, τ_m, by the relationship: $G = 26 + 8.5 \times 10^{-3} (\sigma_f^2 d_f v_f / \tau_m)$. Interrupted slow bend tests were employed to investigate deformation in the specimens. An important mechanism of energy absorption proved to be matrix plastic strain. This was confirmed in tests of Charpy specimens with reduced thickness at constant notch dimensions which exhibited a nearly linear decrease in energy per unit area due to the decrease in shear stress with span to depth ratio. Extensive fractography was conducted using both scanning electron and conventional light microscopy. Three regions, differing in degrees of filament bundle protrusion, characterized the fracture surfaces of longitudinally reinforced materials. The fracture surfaces of transversely reinforced 4.2 mil BORSIC + aluminum materials exhibit extensive fiber splitting, whereas transversely reinforced 5.7 mil BORSIC + aluminum composites do not exhibit significant splitting. (auth)

16152 TOUGHNESS OF BORSIC-Al COMPOSITES WITH WEAK FIBER MATRIX BONDS. Hoover, W. R.; Alfred, R. E. (Sandia Labs., Albuquerque, NM). pp 311-326 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

The toughening mechanism of crack blunting through fiber-matrix debonding in Borsic-Al composites has been examined.

It was observed that a plane stress to plane strain transition in the notch tip stress state can be achieved by increasing the composite thickness to above 0.100". This stress state transition was found to cause a change in (1) the fiber-matrix bond fracture mechanism, (2) the stress level necessary to cause delamination, and (3) the critical strength ratio for delamination. In addition, it has been shown that this delamination behavior renders the composite totally notch insensitive; hence, classical brittle fracture appears unimportant in this Borsic-Al composite. The observations of crack blunting through delamination and notch insensitivity are discussed in light of their effects on design and areas for future work are suggested. (auth)

16153 TENSILE FRACTURE OF UNIDIRECTIONAL B–Al COMPOSITE. Steele, J. H.; Herring, H. W. (Polytechnic Inst., Blacksburg, VA). pp 343-356 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

Fracture studies on unidirectional boron filament-aluminum matrix composite under axial tension were conducted using scanning electron microscopy, microradiography, and an acoustic emission technique. The combination of these analysis techniques has allowed the description and microstructural characterization of a new noncumulative fracture mode which involves filament break propagation. This fracture mode was found to severely limit the tensile strength of the composite since the initiation of break propagation leads immediately to catastrophic failure at filament stress levels above a critical value. This critical filament stress was found to be 170,000 psi and it appeared to be independent of filament diameter, number of filament layers, and the type of matrix alloy. Results of a comprehensive analysis of the fracture surface indicated several different characteristics, the most prominent of which was the fragmentation of the filaments to form wedge-like sections indicating the direction of break propagation. The matrix fracture was characterized by ductile rupture which occurred after filament failure. Results of filament strength evaluation indicated that above the critical filament stress any filament failure would indicate catastrophic break propagation failure. Thus the weakest filaments in the strength distribution control the ultimate strength when filament stresses exceed the critical value by initiating break propagation. (auth)

16154 FATIGUE FAILURE MECHANISM IN BORON ALUMINIUM. Prewo, K. M.; Kreider, K. G. (United Aircraft Research Lab., East Hartford, CT). pp 395-413 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

The tension-tension low cycle fatigue behavior of uniaxially and biaxially reinforced BORSIC–aluminum specimens has been examined. Both 4.2 mil and 5.7 mil diameter reinforced 6061 matrix composites were tested to determine the roles of fiber and matrix in composite deformation and fracture. The role of matrix plasticity in blunting notches has been established and the improvement of composite performance through the use of 5.7 mil diameter fiber has been demonstrated. (auth)

16155 METHOD OF MAKING A HARD ALLOY MATRIX CONTAINING A TUNGSTEN–BORON PHASE. Prasse, H. F.; McCormick, H. E. (to Ramsey Corp.). US Patent 3,809,546. 7 May 1974. Filed date 7 Jan 1970. 12p.

A method of making an novel alloy containing a tungsten-boron phase is described. The alloy comprises a matrix such as a nickel–chromium, or other nickel containing matrix, having therein a separate tungsten-boron phase. The alloy is used as a facing or coating for a number of base materials, and in particular as a piston ring facing for the bearing portion thereof. The invention is particularly directed to a method of making said alloy by utilizing a plasma jet spray technique. (Official Gazette)

16156 DEFECT STRUCTURE OF Ta_2O_5. Stroud, J. E. (Systems Research Lab. Incorporated, Dayton, OH); Tripp, W. C.; Wimmer, J. M. J. Amer. Ceram. Soc.; 57: No. 4, 172-175(Apr 1974).

Electrical conductivity, thermoelectric power, and weight change were measured for polycrystalline Ta_2O_5 from 900 to 1400°C. The predominant ionic and electronic defects in this temperature range are oxygen vacancies and electrons. The oxygen-vacancy and electron mobilities are 8.1×10^3 exp (–1.8 eV/kT) and ≈0.05 $cm^2/V\text{-}s$, respectively. At O_2 partial pressures near 1 atm, the ionic-defect concentration is essentially fixed by the presence of lower-valence cation impurities, and the total electrical conductivity is predominantly ionic, whereas at low P_{O_2}'s the conductivity is electronic and proportional to $P_{O_2}^{-1/4}$. (auth)

16157 STUDIES ON NONMETALS DURING IRRADIATION. V. Growth and Decay of Color Centers in Barium Aluminoborate Glasses Containing Cerium. Levy, P. W. (Brookhaven National Lab., Upton, NY); Mattern, P. L.; Lengweiler, K.; Bishay, A. M. J. Amer. Ceram. Soc.; 57: No. 4, 176-181(Apr 1974).

The radiation-induced absorption of a group of barium aluminoborate glasses was studied in a new facility for measuring optical absorption during irradiation with γ-rays. The results demonstrate that this technique provides significant new information on the kinetics of the radiation-induced coloring of glasses and suggest that most previous measurements are, at best, suspect. Barium aluminoborate glasses, both with and without Ce, were prepared under normal and reducing conditions. The coloring during irradiation and the decay after irradiation can be characterized by the absorption at 3.0 eV and at 2.25 or 1.90 eV. The Ce-free base glass continued to color as long as irradiated and, at a given dose, the absorption was at least 2 or 3 times that of the other glasses. The totally reduced 1% Ce glass colored to a constant level in the uv, but in the visible the coloring increased to a maximum and then decreased to a constant value. The partially reduced 1% Ce glass also colored to a constant value in the uv, but in the visible the original absorption decreased slightly. All the coloring curves recorded during irradiation are described accurately by expressions that include one or more increasing saturating exponential terms and may contain one linear or one decreasing saturating exponential term. After irradiation the coloring curves decrease and can be resolved accurately into one or more decreasing exponential components. Furthermore, all the observed coloring-curve features were derived from relatively simple kinetics. (auth)

16158 SYSTEM Y_2O_3–GeO_2 BELOW 1700°C. Levin, E. M. J. Amer. Ceram. Soc.; 57: No. 4, 189-190(Apr 1974).

The system was studied at temperatures up to 1700°C by a quenching method using Pt tubes to prevent loss of GeO_2 by volatilization. Temperatures were measured using a calibrated Pt–Pt 10 Rh thermocouple. Solidus and liquidus were determined using a polarized microscope, and quenched crystalline phases were identified by x-ray powder diffraction. Phase compositions and crystal structures are described and presented in tables and graphs. (JRD)

16159 REDETERMINATION OF LATTICE PARAMETER OF ThO_2. Leigh, H. D.; McCartney, E. R. J. Amer. Ceram. Soc.; 57: No. 4, 192(Apr 1974).

Highly crystalline ThO_2 was examined by x-ray diffraction. Parameter measuring methods are described and data are presented tabularly. (JRD)

16160 ENTHALPY AND ENTROPY OF FUSION OF ErB_{12}, UB_{12}, AND $Zr_{0.6}Y_{0.4}B_{12}$ BY DROP CALORIMETRY. Mar, R. W. (Sandia Labs., Livermore, CA); Stout, N. D. High Temp. Sci., 6: No. 2, 167-176(Jun 1974).

The fusion behavior of an assortment of dodecaborides was investigated. By means of a cooling-curve technique, $Zr_{0.6}Y_{0.4}B_{12}$, ErB_{12}, and UB_{12} were found to melt at 2328, 2356, and 2418°K, respectively. The enthalpies of fusion were determined by drop calorimetry to be 160.2, 159.7, and 141.2 kcal/mole for $Zr_{0.6}Y_{0.4}B_{12}$, ErB_{12}, and UB_{12}, respectively. (5 tables) (auth)

16161 PRODUCTION OF NIOBIUM CARBIDE IN PSEUDOLIQUID LAYERS. Gal, V. V.; Nikitin, K. A.; Pavlov, Yu. A.; Savinov, V. K.; Skachkova, T. M. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 4, 569-571(1974). (In Russian).

Production of carbides in pseudoliquid layers is possible both by saturation of Nb particles with C and of graphite granules with Nb. Experimental studies showed that continuous diffusion saturation of graphite granules (0.6 to 0.8 mm), using porous PG-50 graphite and $NbCl_5$, can be achieved at temperatures above 2400°C with reaction times of about 10 hr. The process is efficient and economical. (JSR)

16162 UO_2 TEMPERATURE PROFILES. Alayola Rosas, R. A. Mexico City; Universidad Nacional Autonoma de Mexico (1973). 77p. (In Spanish).

Thesis.

The phenomena occurring in UO_2 tablets under irradiation are qualitatively described. The grain growth and the factors affecting it are analyzed. Experimental studies, primarily from Chalk River, on the thermal conductivity of UO_2 and its temperature profiles are summarized. On the basis of these experimental results a curve is drawn of the thermal conductivity of UO_2 under irradiation as a function of the temperature. (JSR)

16163 CARBOTHERMIC REDUCTION OF MIXTURES OF URANIUM AND ZIRCONIUM DIOXIDES. Vlasov, V. G.; Revebtsov, V. V.; Kiselev, V. A. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst.; 42: 106-115(1972). (In Russian).

The rates and mechanism of the carbothermic reduction of ZrO_2 and UO_2 mixtures were studied. The reduction begins at 1600 to 1650°K, and at 1870°K is complete in 1 h. With small degrees of reduction the apparent activation energy is 170 to 210 kJ/mole, but this rises to 230 to 250 towards the end of the process. The suggested mechanism involves the reaction of oxides in the gas phase. The combined process takes place with the formation of a solid solution of UC and ZrC. (Ref. Zh.)

16164 PREPARATION OF SILICIDES OF TITANIUM, NIOBIUM, AND TANTALUM BY THE COMBINED REDUCTION OF THE CHLORIDES BY HYDROGEN. Kozlov, F. N.; Petrusevich, I. V., Donskoii, A. E.; Nisel'son, L. A. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst.; 42: 61-65(1972). (In Russian).

Regression equations were obtained to plan mathematically experiments to determine the effects of temperature and composition of the gas phase on the deposition rate and yield of the mono- and di-silicides of Ti by the reduction by H of gaseous Ti and Si chlorides. Results from tests to produce Nb and Ta silicides show that H reduction of the appropriate higher chlorides will produce Nb_5Si_3 and Ta_5Si_3. (Ref. Zh.)

16165 TERNARY SYSTEM In-S-Se. Rustamov, P. G.; Melikova, Z. D. (Inst. of Inorganic and Physical Chemistry, Baku). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1492-1495(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1673-1676(Oct 1973).

Phase diagrams are presented on the cross sections In_2S_3-Se and In_2Se_3-S, and the liquidus surface of the ternary system In-S-Se. The largest region is occupied by the primary crystallization field of solid solutions $In_2(S, Se)_3$. The reactions taking place during crystallization of the alloys in this ternary system have been determined. (auth)

16166 SYSTEMS YTTRIUM-MOLYBDENUM-BORON AND YTTRIUM-TUNGSTEN-BORON. Kuz'ma, Yu. B.; Svarichevskaya, S. I.; Sobolev, A. S. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1512-1516(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater., 9: No. 10, 1697-1702(Oct 1973).

The phase equilibria and the crystal structures of the phases in the system Y-Mo-B and Y-W-B were investigated using x-ray phase and x-ray structural analyses. Data on the structures of $YMoB_4$ and YWB_4 are presented along with isothermal sections at 1000°C of the systems Y-Mo-B and Y-W-B. (JRD)

16167 TEMPERATURE DEPENDENCE OF THE MICROHARDNESS OF TRANSITION METAL CARBIDES. Koval'chenko, M. S.; Dzhemelinskii, V. V.; Skuratovskii, V. N.; Tkachenko, Yu. G. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1525-1528(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1712-1716(Oct 1973).

The temperature dependence of TiN, ZrN, HfN, NbN, TaN, and WN microhardness was examined. It was found that plastic flow of both monocrystalline and polycrystalline carbides is based on a mechanism of thermally activated dislocation slip; the activation energies of this process were determined and the nominal temperatures of transition of carbides from the brittle to the plastic state were established. The high values for temperatures of transition from the brittle to the plastic state agree with the data from other research. (JRD)

16168 MICROHARDNESS OF ALLOYS IN THE SYSTEM ZrC-NbC (TaC). Ordan'yan, S. S.; Kudryasheva, L. V.; Fishchev, V. N. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1529-1531(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1717-1720(Oct 1973).

Information is presented on microhardness changes in ZrC-NbC, and ZrC-NbC-TaC at 1800 to 2100°C sintering temperatures. Results show that in solid solutions of carbides of transition metals of groups IV and V, the increase in microhardness is attributable not only to the effect of elastic deformation of the crystal lattice, due to differences in dimensional factors, but also to a change in the electronic structure of the carbide phases; this is indicated by the experimentally observed tendency for the microhardness maximum in a series of solid solutions to be displaced towards compositions with a valence electron concentration of 8.2 to 8.4. (JRD)

16169 INTERACTION OF NbC AND ZrC WITH Ni. Leidermap, G. M.; Nikolaeva, V. A. (Inst. of High Temperatures, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1532-1534(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1721-1723(Oct 1973).

Sectors of the phase diagrams of the systems Ni-NbC and Ni-ZrC in the region 0 to 20 wt.% MC were constructed based on the onset temperatures of melting, a study of the microstructure, and measurements of the microhardness. (auth)

16170 PREPARATION OF CARBONITRIDES OF Ti, Zr, V, AND Nb BY NITRIDING CARBON-DEFICIENT CARBIDES. Samsonov, G. V.; Bilyk, I. I.; Morozov, V. V. (Kiev. Polytechnical Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1535-1539(Oct 1973).

Translated from Izv. Akad Nauk SSSR, Neorg. Mater.; 9: No. 10, 1724-1728(Oct 1973).

Formation of carbonitrides of Ti, Zr, V, and Nb during nitriding (t = 900 to 1300°C) of the corresponding carbon-deficient carbides was investigated. It was shown that when carbide phases of Ti, Zr, V, and Nb are nitrided, the carbonitride formation temperature depends on the composition of the carbide phases and their carbon contents. (auth)

16171 ELECTRON-DIFFRACTION INVESTIGATION OF THE STRUCTURES OF FILMS OF THE SYSTEM Al_2O_3-W. Osipov, K. A.; Galkin, B. D.; Urazaliev, U. S. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1547-1549(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1738-1740(Oct 1973).

Results show that in films, aluminum oxide has two modifications, a low-temperature modification (γ) with the structure of a defect spinel, and a high-temperature modification (α) with the corundum structure. In films of the system W-Al_2O_3, no products of reaction of aluminum oxide with tungsten were found. The phase composition of films in the temperature range 700 to 1200°C is W + γ-Al_2O_3; in the range 1200 to 1600°C it is W + α-Al_2O_3. (auth)

16172 SYNTHESIS AND CHARACTERISTICS OF CERTAIN PHASES IN THE SYSTEMS ZrO_2-MoO_3 AND Y_2O_3-MoO_3. Gul'ko, N. V.; Karaulov, A. G.; Taranukha, N. M.; Gavrish, A. M. (Scientific-Research Inst. of Refractories, Kharkov). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1572-1575(Oct 1973).

Translated from Izv. Akad. Nauk SSSR Neorg. Mater.; 9: No. 10, 1766-1769(Oct 1973).

Using solid-phase reactions, $Zr(MoO_4)_2$, Y_6MoO_{12}, and $Hf(MoO_4)_2$ were synthesized and their optical constants established. In the system Y_2O_3-MoO_3 three molybdates were synthesized by solid-phase reactions, namely Y_6MoO_{12}, Y_2MoO_6, and $Y_2(MoO_4)_3$; the first two compounds have never been obtained before. It was shown that Y molybdate with a ratio $Y_2O_3 : MoO_3 = 1:2$ is not formed by a solid-phase reaction. It was confirmed that $Y_2(MoO_4)_3$ adsorbs moisture in air and is converted to the hydrate $Y_2(MoO_4)_3 \cdot 2.8H_2O$. Dehydration takes place at 70 to 220°C and the anhydrous molybdate acquires an orthorhombic structure. The optical and x-ray characteristics of all three Y molybdates are given along with their pycnometric densities. (auth)

16173 SYNTHESIS AND PROPERTIES OF MATERIALS BASED ON TITANATES AND ZIRCONATES OF Ca, Sr, AND Ba AND AQUEOUS SOLUTIONS OF ACIDS. Fedorov, N. F.; Kozhevnikova, L. V.; Lunina, N. M. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1579-1582(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1773-1777(Oct 1973).

The alkaline earth titanates and zirconates were synthesized by roasting stoichiometric compositions at 1300 to 1350°C for 2 to 3 h. Materials exhibiting both high strength and high electrophysical properties were obtained by semidry pressing of powdered titanates and zirconates of Ca, Sr, and Ba, wetted by liquids chemically active with respect to these powders. Materials with a compressive strength of 3600 kg/cm^2 and a bending strength of 500 kg/cm^2 have been synthesized. The electrical properties of the compositions investigated lie in the following ranges: $\rho = 10^7 - 10^{11}\ \Omega \cdot$ cm, $\tan\delta = 0.05 - 0.01$, and $\epsilon = 15$ to 800. Specimens based on alkaline earth zirconates are resistant to temperatures of up to 1000°C. A new highly effective mixing liquid is prepared for obtaining artifacts of oxide compounds, namely a mixture of sulfuric and phosphoric acids. The best results are obtained when the content of initial acids is 40 to 60% H_3PO_4 and 60 to 40% H_2SO_4. (JRD)

16174 BINDING PROPERTIES OF THE SYSTEM ZrO_2-P_2O_5-H_2O DURING AUTOCLAVING. Filippova, N. M.; Chikovani, N. S.; Chemodanov, D. I. (Tomsk Engineering Construction Inst., USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1591-1593(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1788-1790(Oct 1973).

Investigation results show that hardening of zirconium phosphate cement (ZPC) is possible during autoclaving. Under these conditions the strength of the ZPC structures is determined by the composition of the initial mass, its degree of compaction, and the duration of hardening. Investigations of the phase composition of the reaction products have established that structurization during hardening of ZPC during autoclaving is due to formation of an x-ray-amorphous acid phosphate with the formula $Zr(HPO_4)_2$. (auth)

16175 REGION OF HOMOGENEITY OF $MoSi_2$. Nechiporenko, E. P.; Poltavtsev, N. S.; Kapustin, V. L.; Kondratov, Yu. T. (Physical-Technical Inst., Kharkov). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1627-1628(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1829-1830(Oct 1973).

Results of x-ray microspectral studies of $MOSi_2$ homogeneity regions are presented for samples vacuum silicided at 1200 to 1500°C. It was found that the homogeneity resulting from Si diffusion amounts to several %, increasing with reaction temperature. (JRD)

16176 POSSIBILITY OF FORMATION OF STABILIZED ZrO. Alyamovskii, S. I.; Zainulin, Yu. G.; Shveikin, G. P.; Gel'd, P. V. (Sverdlovsk Inst. of Chemistry, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1635-1636(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1837-1838(Oct 1973).

Results of a study are presented on reaction products of ZrO and Zr with FeO, CoO, NiO, VO, NbO, and Y_2O_3. Results are discussed in terms of stabilized ZrO phases. (JRD)

16177 CRYSTAL FIELD DETERMINATION IN RARE-EARTH OXYSULFIDES. III. Specific Heat Measurement on Gd, Tb, Ho, and Dy oxysulfides. Rossat-Mignod, J. (CEN, Grenoble, France); Quezel, G.; Berton, A.; Chaussy, J. Phys. Status Solidi (b); 63: No. 1, 105-114(1 May 1974).

The specific heat of gadolinium, terbium, dysprosium, and holmium oxysulfides has been measured between 1.4 and 80°K. The lattice contribution has been obtained by the analysis of the Gd_2O_2S results. For the terbium, dysprosium, and holmium oxysulfides, the specific heat studies were the basis for removal of ambiguities of optical measurements and to define the crystal field splitting of the rare-earth ground state multiplet. (auth)

16178 METHOD OF PREPARING RELATIVELY LOW DENSITY OXIDE FUEL FOR A NUCLEAR REACTOR. Langrod, K. (to North American Rockwell Corp.). US Patent 3,806,565. 23 Apr 1974. Filed date 2 Aug 1971. 8p.

In the method, UO_2 powder or an intimate mixture of UO_2 and PuO_2 or ThO_2 powders is sintered, the sintered material is comminuted to a fine powder, the fine powder is compacted by cold pressing, and the compact is resintered at approximately the same temperature used for the first sintering. (Official Gazette)

16179 MOLYBDENUM METALIZING ON BERYLLIA. Clark, D. E.; Hench, L. L.; Bates, S. R. (Univ. of Florida, Gainesville). Amer. Ceram. Soc. Bull.; 53: No. 6, 473-477(Jun 1974).

An investigation of silk screened Mo metalizing on sintered high purity BeO substrates has shown that the mechanical properties of the metal/ceramic interface are sensitive to the sintering temperature, but are not dependent on the moisture content of the sintering atmosphere. Evidence is presented for both fusion bonding between Mo powders and BeO grains, and the absence of Mo diffusion into the ceramic lattice. These findings suggest that direct chemical bonding can occur at the BeO/Mo interface. The importance of screening consistency, particle size distribution, and sintering characteristics of the metalizing are also discussed. (13 fig) (auth)

16180 HIGH TEMPERATURE DEFORMATION OF CERAMICS. II. Specific Behavior. Radford, K. C.; Terwilliger, G. R. (Westinghouse Electric Corp., Pittsburgh). Amer. Ceram. Soc. Bull.; 53: No. 6, 465-472(Jun 1974).

The high-temperature deformation of MgO, Al_2O_3, and UO_2 is described followed by a brief description of the typical behavior of MgO–Al_2O_3 refractories. These materials illustrate the effects of crystal structure, composition, microstructure, and environment which have a profound influence on the deformation behavior of ceramics. (14 fig) (auth)

16181 FUEL MATERIALS FOR FAST REACTORS. Horspool, J. M. (United Kingdom Atomic Energy Authority, Windscale, Eng.); Parkinson, N.; Findlay, J. R.; Potter, P. E.; Rand, M. H.; Russell, L. E.; Batey, W. pp 3-16 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

Studies are presented of the effects of compositional variations in mixed uranium–plutonium oxide and carbide fuels on their physical and chemical properties and their relevance to irradiation behavior. The major parameters considered are composition (O/M ratio in oxide, C/O/M ratio in carbides), additives and impurities arising from fuel fabrication operations, and compositional changes resulting from neutron irradiation. Theoretical and experimental data are given on thermal diffusivity and creep, on fuel-clad reactions, and on vaporization, segregation, and mass transfer phenomena in fuel elements. (auth)

16182 PREPARATION OF HIGH-PERFORMANCE NON-OXIDE FUELS: FIRST RESULTS OF FAST FLUX EXPERIMENT DN-1. Richter, K.; Coquerelle, M.; Gaboide, J.; Werner, P. (EURATOM, Karlsruhe, Ger). pp 71-84 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

General data for carbothermic reduction pressures are discussed (influence of starting material, homogeneity, control of degree of reaction, etc.). A survey of different preparation methods investigated is given for the compounds: $MC_{0.3-0.7}N_{0.1-0.3}$; $MC_{0.5}N_{0.5}$; $MC_{0.2}N_{0.8}$. Limitations of temperature and atmosphere for both carbothermic reduction and sintering are summarized. Physico-chemical characteristics of reacted and sintered products are given. A special preparation process for $MC_{0.7}N_{0.3}$ is described and the results discussed. To prove the potential of the advanced fuels, an irradiation experiment of mixed carbide, carbonitride, and nitride fuels at 1250 W/cm is under way in DFR. First results of post-irradiation examinations on the low burnup series of this experiment are summarized; the most striking result is the high fission-gas release measured (60%), especially for (U, Pu)C and (U, Pu)$C_{0.5}N_{0.5}$ fuel. (5 tables, 6 figures) (auth)

16183 CREEP IN URANIUM DIOXIDE. Golovnin, I. S. (All-Union Scientific-Research Inst. of Problems in Materials, Moscow); Bibilashvili, Yu. K.; Men'shikova, T. S.; Miloserdin, Yu. V.; Naboichenko, K. V. pp 185-194 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In Russian).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

Experimental results on creep in uranium dioxide (UO_2) are presented. Descriptions are given of the experimental methods employed and of setups for studying the creep, under compression, of ceramic samples in the laboratory and in neutron fields. The experimental setups were designed for use with the Moscow IRT-2000 reactor and the BR-10 reactor. The authors present UO_2 creep data obtained under laboratory conditions and with the IRT-2000 reactor. A detailed description (covering chemical composition, oxygen coefficient, grain size, etc.) is given of the UO_2 samples which were the subject of the investigations. (7 figures) (auth)

16184 BEHAVIOR OF URANIUM CARBIDE PELLETS IRRADIATED TO HIGH BURN-UPS. Delbrassine, A. (CEN, Mol, Belgium); Coquerelle, M. pp 247-260 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

Under a CEN-SCK (Mol, Belgium) program on advanced nuclear fuels, 36 uranium carbide pellets contained in a POM-type device were irradiated in the Belgian BR 2 reactor. The purpose was to compare the behavior of low and high density fuels, whether stabilized or not with V or Cr, and to study the effect of the C and O contents. In the case of 32 of the pellets, the burnup lay between 60,000 and 100,000 MW · d/t, with a power density of 950 W/g for the pellet with highest burnup. The remaining four pellets were placed in contact with samples of austenitic and ferritic stainless steels, in order to make an in-pile study of the compatibility of these steels with stabilized uranium carbide. After irradiation, the various types of fuel were examined, and it was shown that: (1) C activity does not vary appreciably; (2) fission products do not migrate and do not form new phases visible in the optical microscope; (3) the release rate of fission gases is low; (4) the distribution and form of porosities are dependent on O and C contents and on the presence of V. (auth)

16185 IRRADIATION OF A BROKEN FUEL PIN IN A SODIUM CIRCUIT. Hairion, J. P. (CEN, Grenoble, France); Cauvin,

J. C.; Chenbault, P.; Delmas, R.; Lhermenier, A. pp 261-275 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

In-capsule irradiations in a thermal reactor enabled a continuous measurement to be made of the fission gases released by a sodium-cooled fuel pin exhibiting a burst slug. The pin was filled with mixed-oxide pellets—(U, Pu)O_2—and the cladding was of stainless steel; the linear power was 550 W/cm and the temperature of the can above 600°C. Results revealed different leakage mechanisms, involving no gas release; sodium–fuel interactions accompanied by brief releases of short-lived isotopes; or a powerful rush of gas during drastic drops in temperature. A model is suggested for the leakage mechanism and its consequences considered for the staff operating burst slug detection and localization devices. Gamma spectrometric measurements of the capsule a few hours after shutdown provided abundant data on the distribution of the fission products in the fuel and in the sodium circuit. The radial and/or longitudinal distribution of I, Te, Nb, Sr, Cs, Ce, and Mo in the fuel was found to be perturbed by the presence of a rupture. In the sodium circuit, the principal nuclides found were I, Te, and Cs: the longer the half-life of the isotope, the larger its concentration. The distributions of solid fission products found in the sodium circuit are compared with results obtained from reactor studies. (9 figures) (auth)

16186 REACTION BETWEEN URANIUM MONOCARBIDE AND NITROGEN. Beketov, A. R.; Vlasov, V. G.; Bezdenezhnykh, V. A.; Talinin, V. A. Sov. J. At. Energy (Engl. Transl.); 33: No. 5, 1063-1064(Nov 1972).

Translated from At. Energ. (USSR); 33: No. 5, 916-917(Nov 1972). This is a summary of paper No. 622/6686 with full copy held at TIC.

The kinetics of the reaction of UC with nitrogen in the temperature range 923-1223°K and pressure range 6.67×10^{-3} to 80.0×10^4 N/m^2 is studied. Equations for the reaction are given and reaction constants evaluated. (SFL)

16187 STRUCTURE OF CARBURIZED LAYERS OF Fe–W and Fe–Mo ALLOYS. Bunin, K. P.; Movchan, V. I.; Peden, L. G. (Dnepropetrovsk Metallurgical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 8, 121-124(1973). (In Russian).

The effect of the composition of Fe–W and Fe–Mo alloys, temperature, and carburization time on the structure of the diffusion layers was studied. In the carburization of iron alloys containing carbide-forming and stabilizing ferrite elements, processes of structure formation occur, including recrystallization of ferrite to austenite, separation from solid solutions of special carbides of the type M_6C, and solution of carbide grains. The nonhomogeneous passage of the carbon to the depth of the diffusion layer results in nonhomogeneous structures along the section. The inhomogeneity is due basically to changes in the size and number of carbide inclusions and therefore also to a change in the composition of the solid solution from the surface to the depth of the diffusion layer. (tr-auth)

16188 MICROSTRUCTURE IN SINTERED UO_2 PELLETS. Anandan, N. S.; Moorthy, V. K. (Bhabha Atomic Research Centre, Bombay). Trans. Indian Ceram. Soc.; 31: No. 5, 113-117(Sep 1972).

The influence of powder properties and sintering treatments on the development of microstructure in sintered UO_2 pellets was studied. The nature and type of porosity and grain morphology are influenced by the calcination temperature and sintering treatment and these influences persist even at a high sintering temperature. (auth)

16189 U–Se–Te SYSTEM. Ellert, G. V.; Slovyanskikh, V. K. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 5, 1389-1394(May 1974). (In Russian).

The interaction in the low-temperature part (up to 1250°C) of the U–Se–Te (0-35 at.% U) was studied. The limits of primary crystallization of the phases and the location of the nonvariant points were determined. (tr-auth)

16190 EXPERIMENTAL AND MODELING RESULTS CONCERNING THE OPERATIONAL BEHAVIOR OF A SNR-TYPE FUEL PIN. Kummerer, K.; Elbel, H. (Kernforschungszentrum, Karlsruhe, Germany). pp 3-24 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The experimental efforts within the development program for the SNR-300 fuel pin culminate in representative bundle irradiations, while the theoretical activities concentrate on fuel pin modeling and its comparison with experimental results. Irradiation of the DFR-350 fuel pin bundle, an essential for the construction decision of the SNR-300 prototype, is briefly described. Furthermore, the fuel pin modeling code SATURN-1 is presented and discussed. The post-irradiation examination results of a single fuel pin out of the DFR-350 bundle are evaluated in detail and accompanied by a modeling calculation using the SATURN-1 code. In this comparison the fuel structure, including central hole, porosity and cracks, along with swelling and creep of the cladding are involved. The next step comprises a detailed modeling calculation for a standard fuel pin of the SNR-300 reactor. For this calculation about ten cross-sections within the fuel region of the pin are examined. This leads to a set of theoretical performance data which may serve as a first guideline for the behavior of such a pin. A system analysis of the nominal SNR-300 pin is outlined. In this context the fuel porosity, the gap clearance, and the start-up time are used as independent variables, leading to the variations in central temperature and contact pressure build-up. In this way the fuel pin modeling results allow a look at the relevance of fabrication and operation parameters as well as the possibilities and potentials for specification changes and burnup increase. (auth)

16191 INVESTIGATION OF METHODS OF MANUFACTURING FAST REACTOR FUEL ELEMENT PINS FROM URANIUM MONOCARBIDE, MONONITRIDE, AND CARBONITRIDE. Reshetnikov, F. G.; Kotel'nikov, R. B.; Rogozkin, B. D.; Bashlykov, S. N.; Samokhvalov, I. A.; Titov, G. V.; Shishkov, M. G.; Belevantsev, V. S.; Fdorov, Yu. E.; Simonov, V. P. (All-Union Scientific-Research Inst. of Problems in Materials Science, Moscow). pp 25-46 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In Russian).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The basic theory of processes is considered for making refractory compounds from uranium dioxide in fluidized beds in different gas atmospheres. A continuous production process is described for uranium sesquinitride based on the interaction of uranium metal with gaseous reagents. A continuous production process is also described for uranium monocarbide and nitride based on the interaction of uranium dioxide with carbon in different gas atmospheres. The relative characteristics of monocarbide, carbonitride, and mononitride powders obtained by different methods (specific area, grain size, grain shape, bulk density, and chemical and spectral analysis) are discussed. Different methods of forming billets for subsequent sintering are described and the effects of the forming pressure and the quantity and nature of the binding agent on the density, mechanical strength, and elastic creep of the billets is discussed. The results of an investigation of the effects of sintering conditions, powder grain size, impurity content, and type of atmosphere on the density, structure, shrinkage, geometrical accuracy, and phase composition are presented. Possibilities of combining the compound-producing and sintering processes are examined. The statistical characteristics of sintered pins, such as the density, size, and composition distributions are considered and the filling densities of cans with pellet and rod type pins are compared. (auth)

16192 SIMPLIFIED APPROACH TO COMPARE THE MECHANICAL INTEGRITY OF DIFFERENT FUEL PIN CONCEPTS CALIBRATED AGAINST IN-PILE MEASUREMENTS. Plitz, H.; Senski, G. (Kerneregieversuchsanlage, Grosswelzheim, Ger.). pp 47-65 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

After short irradiation time the fuel/clad gap in fast fuel pins is closed by fuel thermal expansion, fuel cracking, and burnup swelling, as proved by in-pile experiments. Therefore a contact pressure between fuel and clad builds up. Assuming a balance between stress build-up by fuel thermal expansion and swelling and stress relaxation by creep of fuel and clad, a simplified computer program has been developed to calculate stresses and creep strains in fuel pins. The model also includes the effects of radial fuel cracking. This program has been calibrated against in-pile measured clad strains of fuel pins mounted in the well-instrumented diameter rig at Halden reactor. Calculated and measured results were in good agreement, e.g., during a power ramp from 100 to 600 W/cm and down to 200 W/cm within 40 hours. These findings and the comparison with other irradiation results are encouraging for prediction and comparison of the mechanical integrity of different types of fast fuel pins. Applying this model to fast fuel pins, it is found that the variation in published materials data, especially creep and swelling rates, determines the reliability of the results. It was therefore concluded

that a simplified method is adequate for design purposes. Available materials data have been applied for parametric studies. With typical design and averaged materials data for oxide- and carbide-fueled pins in fast reactors with different coolants, the equilibrium fuel and clad stresses, stress build-up, and relaxation are calculated as functions of heat-rating level, ramp height, clad temperature, radial crack length in fuel, and time. (auth)

16193 CODES AND METHODS OF CALCULATION USED FOR THE EVALUATION OF FAST FUEL ELEMENT PERFORMANCE. Burger, M.; Clotter, G.; Leclere, J.; Oswald, M. (CEN, Cadarache, France). pp 67-83 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 2); CONF-730726-P2.

Present efforts relate to the development of models describing the phenomena of critical importance for fuel element behavior. Two codes are described for studying the mechanical behavior of cans. The VULKIN code takes account of radial thermal gradient, fission gas pressure, and swelling due to neutron flux, regarding them as symmetrical revolution stresses. The PASTEL code is more general and can, for example, integrate circumferential gradients. Plastic flows, instantaneous or creep, are determined in each of these codes. The mechanical interaction between fuel and can is not included in them and is handled by a separate model. Each of these models is described and results obtained with them are given. (auth)

16194 CALCULATIONS OF IN-PILE BEHAVIOR OF CARBIDE FAST BREEDER FUEL PINS BY MEANS OF SATURN-1. Vollath, D.; Elbel, H.; Fiedler, H (Kernforschungszentrum, Karlsruhe, Ger.). pp 85-94 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

Owing to several advantages, such as improved breeding and neutron physical qualities as well as higher heat conductivity, carbide fast breeder fuel has been regarded as an alternative to oxide fast breeder fuel for future development. A number of irradiation experiments have been carried out to compare different pin designs using carbide fuel, from the results of which some disadvantages of carbide compared to oxide fuel can also be seen. They are caused by different materials behavior such as cracking, swelling, and creep. Moreover, it has been shown that high-density fuel must be given priority over low-density fuel and over annular pellets. In addition, cracking of pellets, especially sodium-bonded, can have unfavorable results. From the stress distributions obtained by calculations using the SATURN-1 computer code in the fuel after reaching full power, conclusions can be drawn concerning the cracking behavior of the pellets which, in connection with swelling and creep, had a decisive influence on the operation time obtainable. Using various computer results, the different fuel pin designs are discussed, with particular reference to the power density which can be reached with different pin diameters. (auth)

16195 OPTIMIZATION AND ANALYSIS OF FACTORS INFLUENCING THE PERFORMANCE OF CARBIDE FUELS. Board, J.; Eaton, J. R. P.; Haigh, R. E. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). pp 95-112 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 2); CONF-730726-P2.

A model of the irradiation behavior of interacting carbide fuel based on the "cold rim" theory has been developed, and two computer codes POPSIE and POPSTRA are used to calculate the stress distribution in the fuel and clad under steady-state and transient conditions. The significance of factors affecting carbide fuel endurance is discussed. These include irradiation creep hardening of the clad, low irradiation creep of the fuel, void swelling of the cladding, and porosity sintering in the fuel. The factors influencing the performance of sodium-bonded carbide fuel are also reviewed. These include wire-wrap indentation, loss of bond, and internal stressing of the cladding from differential void swelling. An optimization of carbide fuel to achieve high burnup has been carried out. Particular emphasis has been placed on achieving low fuel-center temperatures in the case of the sodium-bonded fuel. The carbide-fueled fast reactor gives substantially better breeding gains than the oxide-fueled fast reactor, and the value of this improved breeding has been assessed for a range of values of plutonium and also by DISCOUNT calculations, which indicate the fast reactor system fraction and fast reactor system cost. (auth)

16196 EXPERIMENTAL IRRADIATION OF SODIUM-BONDED CARBIDE FUEL IN RAPSODIE. Glottes, G. (CEN, Cadarache, France); Dieumegard, M.; Dufayet, J. P.; Groff, A.; Kryger, B.; Mikailoff, H.; Ratier, J. L. pp 113-127 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

A series of fuel elements based on the mixed carbide ($U_{0.8}$, $Pu_{0.2}$)C was irradiated in the Rapsodie reactor. The maximum linear power was 800 W/cm, the cladding temperature 650°C and the burnup 27000 MWd/t. Results are presented relating to the effectiveness of the sodium bond, dimensional variations, fission gas release, and fuel swelling. (auth)

16197 SOME PROBLEMS IN MANUFACTURING LOW-DENSITY UO_2-30 wt.% PuO_2 PELLETS. Flipot, A. J. (CAN/SCK, Mol, Belgium); Lemaire, R. pp 359-375 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The problems discussed cover three essential areas: the technology of pelletization, the problems related to the formation of a wide solid solution (U, Pu)O_2, and the effect of various parameters on the O/M ratio in UO_2-30 wt% PuO_2. Technological difficulties are connected with the objective of manufacturing a high-quality product reliably and economically. Properties of UO_2 powders such as sinterability and flow-rate affect the fabrication route. The technology of pelletization has also been improved. Among the main improvements, direct lubrication of the pelletizing tools, development of sophisticated filling shoes, and use of hydraulic compensation must be emphasized. Rotary presses present a new possibility to the plutonium fuel manufacturers and will be more and more attractive with the increasing demand for small pellets. The diffusion rate of plutonium and the O/M ratio of the fuel depend on the characteristics of the raw materials and the sintering conditions. Ceramographic, autoradiographic, and x-ray examinations reveal that an extended solid solution can be obtained. The O/M ratio can range within wide limits. The pellets can be very hypostoichiometric when sintered in a dry reducing atmosphere such as in a small laboratory furnace equipped with radiation screens. On the other hand, in large batches of pellets sintered in an industrial continuous furnace, the O/M ratio is high. The stability of a relatively small O/M ratio is difficult to obtain. In any case, hypostoichiometric pellets tend to stoichiometry with the storage duration at room temperature in a moist air atmosphere. (auth)

16198 FABRICATION OF PLUTONIUM AND ENRICHED URANIUM FAST REACTOR CORES IN FRANCE. Bailly, H. (CEN, Cadarache, France); Ganivet, M.; Heydraud, J. pp 377-395 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The whole process of fabrication of the first Phénix core is described, including specific manufacturing procedures and the overall organization of the production line. Certain properties of the products thus obtained are described, and the fuels of Rapsodie and Phénix are compared. The experience gained with the first Phénix core augurs well for the fabrication of fast reactor cores for future commercial power stations. In fact the most important extrapolation took place between Rapsodie and Phénix. (auth)

16199 PRODUCTION OF MIXED-OXIDE FUEL FOR FAST REACTORS. Funke, P.; Lins, W.; Schneider, V. W. (ALKEM GmbH, Grossauheim, Ger.). pp 397-409 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

By production of fuel rods for irradiation experiments, ALKEM has gained increasing experience in manufacturing mixed-oxide fuels for fast reactors. Theoretical calculations and production runs to fabricate mixed-oxide fuel with a low O/M ratio on a semi-industrial scale are reported. Hypostoichiometric oxide fuel with an O/M ratio in the range of 1.92 to 1.98 reacts quickly with water and oxygen at temperature above 100°C. There is also a relation with O/M ratio and residual gas. The analytical methods

for O/M and water determination must therefore be modified. Powder characteristics and sintering to size are other points to be discussed. A brief description of the existing Pu fuel production facility with a capacity of 10 tons/y of fast breeder fuel together with the flow diagram is also given. (auth)

16200 PRODUCTION OF SNR FUEL PINS BY BELGONUCLEAR. Leblanc, J. M. (Belgonuclear, Brussels). pp 411-422 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

Alkem and Belgonucleaire have to fabricate the UO_2-PuO_2 fuel pins for the first core and following reloads of the SNR reactor to be built at Kalkar (Fed. Rep. Germany). The fuel specification and the fabrication flow sheet chosen for the fuel of the first core are described. However, some important points are not yet settled concerning, for instance, the characteristics of feed materials (UO_2 and PuO_2 powders), particle size, sintering to size without grinding, stoichiometry of the finished pellets, and the sintered density. These remaining problems are discussed and some solutions which could be adopted by Belgonucleaire are proposed. A description of the existing plutonium fuel production facilities located at Dessel (Belgium) is also given. (auth)

16201 MANUFACTURE OF THE FIRST FUEL ELEMENT CHARGE FOR THE PROTOTYPE FAST REACTOR. Davidson, A. S.; Moulding, T. L. J. (British Nuclear Fuels, Ltd., Seascale, Eng.). pp 423-440 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The plant design philosophy is discussed and a description given of the plant constructed at the Windscale Works of British Nuclear Fuels Ltd for the fabrication of fast reactor fuel elements. An account is given of the work involved in commissioning the plant, which is designed for a high degree of remote operation. The operating experience and subsequent manufacture of the first charge of fuel elements for PFR is reviewed. (auth)

16202 URANIUM-PLUTONIUM MIXED-OXIDE FUEL FABRICATION FOR THE EXPERIMENTAL FAST BREEDER REACTOR JOYO IN JAPAN. Akutsu, H.; Matsumoto, K. (Power Reactor and Nuclear Fuel Development Corp., Ibaraki-Ken, Japan). pp 441-464 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

Keeping pace with the reactor construction schedule, plutonium fuel technology has been studied since 1966, and several series of irradiation tests have been carried out to assess fabrication techniques. Fabrication of the initial core fuel elements for Joyo involving about 1000 kg of mixed-oxide fuel began in November 1972. Much information from fabrication and inspection, measured in absolute values rather than by the "Go, No-go" system, is being collected and processed by means of an electronic computer and is to be used for comparison with the results of reactor operation and post-irradiation examinations which will be conducted in the fuel monitoring facility, the material monitoring facility and the alpha-gamma facility adjacent to the reactor. Two sets of semi-automatic inspection systems of cladding tubes are used in which the analogue values of inspection data are converted to digital values. The mechanical powder blending process is selected to increase the throughput rate, as the mixed oxide contains 18 wt% PuO_2 and 82 wt% UO_2 which is enriched in ^{235}U by 23%. Careful blending and ball-milling are applied to meet the strict specifications on homogeneity and pellet density in the finished pellets. Powder characterization and close process control during pelletizing and sintering are essential to obtain a high yield of the products. To avoid unnecessary radiation exposure of the operators to plutonium, various kinds of automatic equipment are utilized in the process such as diameter selection and density measurement of the pellets, pellet transfer system, pellet loading into cladding tubes, and end-plug welding. The experiences during the first phase of fabrication and the quality assurance operations are described. (auth)

16203 SUMMARY AND PANEL DISCUSSION: KEY ISSUES IN UTILIZATION OF OXIDE FUEL. pp 467-481 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

A review of each conference session is presented. Information is included on carbide fuels and models and calculations for oxide fuel elements. (JRD)

16204 CRYSTAL STRUCTURE, MAGNETIC SUSCEPTIBILITY AND ELECTRICAL CONDUCTIVITY OF PURE AND NiO-DOPED MoO_2 AND WO_2. Ben-Dor, L.; Shimoy, Y. (Hebrew Univ. of Jerusalem, Israel). Mater. Res. Bull.; 9: No. 6, 837-844(Jun 1974).

Single crystals of MoO_2 and WO_2, pure and doped with NiO, were grown by chemical transport in Vycor ampoules using iodine as the transporting agent. From x-ray diffraction analyses, all the crystals were monoclinic, and doping up to 5% does not change the unit cell constants. The pure dioxide crystals are weakly paramagnetic $\chi_M < 100 \times 10^{-6}$ emu, but doping raises the magnetic susceptibility markedly: $\sim 2500 \times 10^{-6}$ emu. Resistance studies show that these materials are metallic conductors, the room temperature specific resistivity being of the order of $10^{-4}-10^{-3}$ Ωcm, decreasing by one order of magnitude at liquid nitrogen temperature. Doping also substantially lowers the conductivity. (auth)

16205 HIGH TEMPERATURE X-RAY DIFFRACTION STUDIES ON Cr-DOPED V_2O_3. Chandrashekhar, G. V.; Sinha, A. P. B. (Purdue Univ., West Lafayette, Indiana). Mater. Res. Bull.; 9: No. 6, 787-798(Jun 1974).

X ray powder diffraction on high purity $(Cr_{0.01}V_{0.99})_2O_3$ and $(Cr_{0.033}V_{0.967})_2O_3$ prepared by the arc-melting technique was carried out in the temperature range of room temperature to 500°C. The room-temperature rhombohedral structure of $(Cr_{0.01}V_{0.99})_2O_3$ is found to undergo, in agreement with earlier results, a gradual transition to an isomorphous, high-temperature rhombohedral structure over a temperature range of 50-200°C. The percentage of the two phases in this coexistence range was determined at different temperatures from the relative x-ray intensities. This is found to depend on the thermal history of the sample and shows considerable hysteresis between heating and cooling cycles. Annealing of the material at 1600°C is found to stabilize the low-temperature form and to broaden the temperature region of the transition. The temperature interval of the electrical anomaly correlates well with the two-phase interval. The lattice parameters and their temperature coefficients were determined for all the phases. (auth)

16206 CHARACTERIZATION OF WURTZITE TYPE BORON NITRIDE SYNTHESIZED BY SHOCK COMPRESSION. Soma, T.; Sawaoka, A.; Saito, S. (Tokyo Inst. of Tech.). Mater. Res. Bul.; 9: No. 6, 755-762(Jun 1974).

Graphite-like boron nitride was shock-compressed up to 550 kbar. The x-ray diffraction pattern of the recovered specimen identified the wurtzite structure whose hexagonal cell dimensions were $a_0 = 2.553 \pm 0.003$ Å, $c_0 = 4.228 \pm 0.004$ Å. No trace of zinc blende form was found. The conversion rate was related to the crystallization of the starting material. The density of the wurtzite type boron nitride was proved to be smaller by about 1% than that of zinc blende type boron nitride synthesized under static compression. (auth)

16207 RAPID QUENCHING ON THE BINARY SYSTEMS OF HIGH TEMPERATURE OXIDES. Suzuki, T.; Anthony, A. (Centre de Researches, Cedex, France). Mater. Res. Bull.; 9: No. 6, 745-754(Jun 1974).

46 high temperature binary oxides were rapidly quenched from the liquid state. The structure of the quenched oxides were examined by X-ray diffraction. 12 systems have produced pure non-crystalline solid (NCS) and 12 systems have formed NCS + crystal. The NCS forming region was represented by plotting the radius ratio of cation vs the number of oxygens par cation. There is a line from the system $ZrO_2-Nb_2O_5$ to the NiO-BaO under which NCS was not obtained. Most systems were made into NCS above this line. (auth)

16208 GROWTH OF GARNET FILMS BY LIQUID PHASE EPITAXY. Stein, B. F. (Sperry Univac, Blue Bell, PA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 48-62(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

A detailed discussion of the growth of garnet films by liquid phase epitaxy is presented. The growth technique and the factors which either directly or indirectly affect the magnetic properties of the film are discussed. Some of these factors are: oxide depletion which results from film growth; flux loss by volatization; and preferential oxide depletion produced by both nonunity and temperature dependent distribution coefficients. Quantitative estimates are made of these effects and a control scheme to control film properties within narrow specifications will be proposed. This scheme has been used successfully to control film thickness, magnetization, and the bubble collapse field of $Y_{2.4}Eu_{0.6}Fe_{3.9}Ga_{1.1}O_{12}$ films. Growth of various compositions including those which support submicron diameter bubbles are also discussed. (auth)

16209 MULTIPLE GARNET FILM GROWTH BY LPE. Warren, R. G.; Mee, J. E.; Stearns, F. S.; Whitcomb, E. C. (Rockwell International, Anaheim, CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 63-67(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Liquid phase epitaxy (LPE) film growth has been shown to provide device quality films utilizing several different flux systems. Using $PbO-B_2O_3$ system films have been grown of nominal $Y_{2.14}Eu_{0.56}Tm_{0.32}Ga_{1.1}Fe_{3.9}O_{12}$ composition simultaneously on eight 1¼ inch diameter gadolinium gallium garnet substrates. Each of these films has uniform film thickness and composition across the substrate, excluding small wafer edge effects. The thickness uniformity is within one interference fringe using the sodium D line which is 0.13 μm. Films grown during one run, which involves up to eight films, have essentially the same magnetic characteristics. The physical arrangement of the equipment for this pilot line sized effort is described. Details of a horizontal substrate holder are discussed and the specifics for obtaining the film parameters are given. (auth)

16210 CHARACTERISTICS OF $Y_{3-x}Ca_x(Ge,Si)_xFe_{5-x}O_{12}$ BASED EPITAXIAL FILMS FOR MAGNETIC BUBBLE APPLICATIONS. Geusic, J. E.; Smith, D. H.; Van Uitert, L. G.; Vella-Coleiro, G. P. (Bell Telephone Labs., Inc., Murray Hill, NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 69(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Studies of electronic propagation margins of this material at 0.06 MHz show that reliable operation over a broad operating temperature range is achieved at high rotating field frequencies. With these new garnet compositions, the operation of bubble devices at rotating field rates up to 1 MHz and over a temperature range −10 to 100°C can now be expected. (JRD)

16211 EFFECT OF SUBSTRATE ORIENTATION AND GROWTH TEMPERATURE ON THE MAGNETIC ANISOTROPY OF $Eu_xY_{3-x}Fe_5O_{12}$ FILMS. Plaskett, T. S.; Klokholm, E.; Cronemeyer, D. C. (IBM Research Center, Yorktown Heights, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 75-79(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Garnet films of $Eu_xY_{3-x}Fe_5O_{12}$ of (100), (110), and (111) orientations were grown by the LPE technique from $PbO:B_2O_3$ fluxes at growth temperatures (T_G) between 744 and 884°C. The compositions of the films were between x = 1.0 and x = 2.1. The growth component (K_u^G) of the induced anisotropy for the (100) oriented films varied from negative to positive as T_G decreased. For the (111) and (110) films K_u^G was positive and varied slightly with T_G. The K_u^G for the (100) films for a constant T_G increased in magnitude with Eu content. The K_u^G cannot be explained entirely by the prevalent models. It is postulated that the K_u^G has a component dependent upon the Pb content of the film. (auth)

16212 MISFIT STRAIN IN LPE $(Y,Eu)_3(Fe,Ga)_5O_{12}$ GARNET FILMS. Makino, H.; Hibiya, T.; Matsumi, K. (Nippon Electric Co., Ltd., Kawasaki, Japan). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 80-84(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Misfit strain in epitaxial magnetic garnet films has been quantitatively investigated for $Y_{3-x}Eu_xFe_{3.5}Ga_{1.5}O_{12}$ deposited on (111) $Gd_3Ga_5O_{12}$ substrate by liquid phase epitaxy (LPE) techniques. By the x-ray double crystal method, measurements were carried out on the bending curvature, from which strain parallel to the surface, ϵ_x, was directly derived. For small misfits, ϵ_x is proportional to Δ_a, as expected from Besser's Region I model. However, in the region of $\Delta_a \leq -0.02$ Å, it was confirmed that a distinct transient region exists between Region I and II, and some part of the elastic stress is relieved during the film growth. Degree of the elastic stress relief increases gradually with further increasing $|\Delta_a|$. Similar conclusions were derived from rocking curve measurements using symmetric and asymmetric reflections. (auth)

16213 NEUTRON IRRADIATION OF LPE BUBBLE DOMAIN GARNETS. Sery, R. S.; Irons, H. R. (Naval Ordnance Lab., Silver Spring, MD). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 90-94(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Five liquid phase epitaxy (LPE) iron garnets were irradiated in two steps to a total of 2×10^{15} n/cm² ($E_n > 10$ keV). Samples included GdEr-, GdY-, GdYTm-, GdYYb-, and GdYLa-IG's. Pre- and post-irradiation measurements were made of l, $4\pi M_s$, H_0, H_k and μ_w. A pre-irradiation simulation of ambient reactor conditions showed that the properties were not affected by these influences. Post-irradiation measurements revealed that negligible changes in properties had occurred. The estimated number of point defects produced in the samples is ~1/10 of what would be required to cause threshold of damage property changes. (auth)

16214 LPE GARNET FILMS WITHOUT HARD BUBBLES. Smith, A. G.; Kestigian, M.; Bekebrede, W. R. (Sperry Research Center, Sudbury, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 167-171(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

In previous studies of hard bubbles, these anomalous domains were found to exist in all unimplanted single-layer liquid phase epitaxy (LPE) garnet films at room temperature. Five garnet film compositions in which it is not possible to generate hard bubbles at room temperature were prepared. These compositions are $Y_{0.9}Gd_{1.2}Tm_{0.9}Fe_{4.6}Al_{0.1}Ga_{0.3}O_{12}$, $Y_{0.9}Gd_{1.5}Yb_{0.6}Fe_{4.5}Al_{0.5}O_{12}$, $Y_{1.6}Gd_{1.0}Er_{1.0}Fe_{4.5}Al_{0.1}Ga_{0.4}O_{12}$, $Y_{1.8}Eu_{0.75}Gd_{0.75}Fe_{4.4}Al_{0.5}Ga_{0.1}O_{12}$, and $Y_{2.0}Tm_{1.0}Fe_{4.1}Ga_{0.9}O_{12}$. All these films were prepared by standard LPE growth techniques and were not ion implanted or provided with any additional layers. The absence of hard bubbles in these films was inferred from the fact that all bubbles collapse within a 1.5% range of bias field even when the bubbles are generated by all the known techniques which normally produce hard bubbles. The dynamic behavior of these bubbles differs with the material composition. Some of these data indicate the presence of a small number of Bloch lines; however, the bubbles in one material all propagate at the same angle to a field gradient which seems to indicate the complete absence of Bloch lines. A common feature of all five compositions was that $q = H_k/4\pi M < 5$. This is apparently a necessary condition as is demonstrated by data presented on similar compositions with $q > 5$ which do exhibit hard bubbles. The effect of temperature on the behavior of these materials is also discussed. (auth)

16215 CONTROLLED COMPENSATION WALLS AND COMPROMISE COMPENSATION WALLS IN GARNET FILMS BY THE SILICON ANNEALING TECHNIQUE. LeCraw, R. C.; Wolfe, R. (Bell Telephone Labs., Inc., Murray Hill, NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 188-192(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

The Si annealing technique has been used on Ga-substituted liquid phase epitaxy (LPE) bubble garnet films to reduce $4\pi M$ through zero and produce controlled, well-defined compensation walls. A Si film was deposited on a garnet film, patterned photolithographically, and annealed at 525°C for 40 hours in O_2. This produced light and dark Faraday contrast regions separated by compensation walls which were independent of the bias field H_0. In the course of annealing, a new type of domain was observed. After 20 h of annealing, the walls between the light and dark areas became fuzzy at $H_0 \sim 80$ Oe. At ~120 Oe they abruptly began expanding over large areas forming a grey (or 3rd color) domain corresponding to ~0° Faraday rotation. The model is as follows: At 20 h, under the Si, a compensation plane ($4\pi M = 0$) is produced near the middle of the film and approximately parallel to the surface. In small H_0 a "compromise compensation wall" perpendicular to the surface separates the light and dark areas. As H_0 is increased >80 Oe, the wall changes its shape to conform to the zero $4\pi M$ plane producing a true compensation wall. The two regions above and below this plane tend to cancel in rotation and create the new kind of grey domain. A new type of mobile grey bubble is also described. (auth)

16216 MAGNETIZATION PROCESSES INVOLVING PLANAR COMPENSATION WALLS. Voegeli, O.; Moore, E. B. (IBM Corp., San Jose, CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 193 (1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Annealing of chemically deposited $Gd_3Fe_5O_{12}$ films on single crystal $Gd_3Ga_5O_{12}$ substrates at temperatures above 800°C causes appreciable cation cross-diffusion between film and substrate, as is evident from Auger composition analyses across the film-substrate interface. The resulting Ga concentration profile through the film thickness determines the position of a compensation plane, which separates the film into two layers, one being above and the other below compensation temperature. Depending on the direction of magnetization in each layer, there exist, as a function of a field applied along the film normal, four different states of magnetization. Recordings of Faraday rotation versus applied field show antiparallel magnetization at low fields and parallel magnetization at high fields. The latter state requires the formation of a planar compensation wall about the compensation plane, whose energy, in combination with the field interaction energy of each layer, determines the equilibrium state at any given field value. As the position of the compensation plane changes with temperature, so do the magnetic moments of the two layers and different sequences of states occur during magnetization reversal at different tempera-

tures. Respective sequences and associated transition field values are accurately predicted by assuming that a transition between two successive states occurs when the energy difference between these states equals some coercive energy barrier. The height of this barrier is proportional to the thickness of material whose magnetization reverses during the transition. (auth)

16217 EFFECT OF A CONSTANT IN-PLANE MAGNETIC FIELD ON MAGNETIC BUBBLE TRANSLATION IN $(YGdTm)_3(FeGa)_5O_{12}$. Bullock, D. C. (Texas Instruments Inc., Dallas). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 232-236(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Bubble translational velocity studies on ion implanted epitaxial garnet films of $(YGdTm)_3(FeGa)_5O_{12}$ have demonstrated that several discrete deflection angles for a given bubble diameter can be obtained between the bubble velocity, $\overline{V}$, and the direction of maximum field gradient, $\overline{\nabla H}_m$, with one of the angles predominating. These angles are interpreted by a theory due to Slonczewski. These deflections can be suppressed by the application of a constant in-plane magnetic field of magnitude greater than or equal to 110 Oe which stabilizes the two Bloch line magnetic bubble. An increase in bubble velocity is also observed when the in-plane magnetic field is applied. (auth)

16218 TEMPERATURE VARIATION OF MAGNETIC BUBBLE GARNET FILM PARAMETERS. Sandfort, R. M.; Shaw, R. W.; Moody, J. W. (Monsanto Co., St. Louis). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 237-241(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

The dynamic response of domain walls to a step change in bias field both with and without an in-plane field has been measured from −10 to 60°C in $Sm_{0.4}Y_{2.6}Fe_{3.7}Ga_{1.3}O_{12}$, $Eu_{0.8}Y_{2.4}Fe_{3.7}Ga_{1.3}O_{12}$, and $Eu_{0.5}Y_{2.35}Yb_{0.15}Fe_{3.5}Ga_{1.5}O_{12}$ garnet films. In addition, characteristic length, saturation magnetization, domain wall energy density, anisotropy field, and coercivity have been measured up to the Neel transition. Domain wall mobility was found to increase by a factor of two over this temperature range as expected theoretically. Wall mobility also increased by a factor of two upon application of an in-plane field of 25 Oe. Over this temperature range the wall coercivity varied by an order of magnitude. (auth)

16219 OBSERVATION OF STRAIGHT AND WAVELIKE DOMAIN WALL MOTION IN BUBBLE FILMS BY HIGH SPEED PHOTOGRAPHY. Morris, T. M.; Malozemoff, A. P. (IBM Research Center, Yorktown Heights, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 242-246(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

The motion of domain walls in garnet bubble films has been studied by means of a high speed photographic technique with 10 ns resolution. A straight, isolated stripe was stabilized in a dc bias field, and a strong reverse field pulse was applied. Initially the two walls remained straight as the stripe expanded. This wall motion proceeded with a saturation velocity which was generally higher than but within 50% of that determined from dynamic bubble collapse. After the stripe had widened to typically several times its initial size, a wavelike distortion with a characteristic wavelength developed on each side of the stripe. A simple magnetostatic model is shown to predict such a wavelike instability at the observed stripe width and wavelength. (auth)

16220 ANISOTROPIC KONDO RESISTANCE IN Fe DOPED $NbSe_2$. Morris, R. C.; Young, B. W.; Coleman, R. V. (Univ. of Virginia, Charlottesville). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 292-296(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

The resistivity and magnetoresistivity of $NbSe_2$ single crystals doped with iron have been measured in the temperature range 1 to 70°K. The crystals were grown with iron concentrations ranging from 0.25% to 5.0% and in zero magnetic field a strong resistance minimum is observed in the 10 to 15°K range followed by a relative maximum in the 1 to 5°K range. For magnetic fields perpendicular to the layers the increase in resistivity below the minimum is enhanced while for magnetic fields parallel to the layers the resistivity increase can be completely quenched. The detailed behavior is dependent on the iron concentration and has been studied in fields up to 151kOe. Hysteresis in the temperature dependent resistivity has been observed and along with other effects suggests that some spin ordering may take place. (auth)

16221 SINTERING BEHAVIOR OF ULTRAFINE NbC AND TaC POWDERS. Sautereau, J.; Mocellin, A. (Ecole Nationale Superieure des Mines, Paris). J. Mater. Sci.; 9: No. 5, 761-771 (May 1974).

Compositional and microstructural changes upon firing ultrafine (300 to 400 Å) stoichiometric NbC and TaC powder lots were studied up to a temperature of 1600°C. Substantial amounts of oxygen impurities, mostly oxide particles or layers are eliminated by reductions with hydrogen, free carbon, or the carbides themselves. TGA showed these reactions to take place at 700 to 1400°C with maxima around 1000 to 1100°C. Low-temperature sintering is inhibited by this impurity and its removal is thus essential. Other impurities (Ni, Cr, Fe) were also found in the starting powders in total concentration 0.5 to 1%. They give rise to a liquid phase located at grain edges at temperatures as low as 1100°C which then controls microstructure development. It dissolves to some extent in the carbide matrix at high temperature, and has a tendency to rise to the free surface of the samples. Compositional and structural heterogeneities are thus produced between bulk and surface at high temperatures. Owing to these impurity effects, it was not possible to clearly evaluate the influence of powder granulometry. (auth)

16222 CHANGE OF DIELECTRIC PROPERTIES OF T-8000 MATERIAL DUE TO ELECTRON- AND PROTON-IRRADIATION. Zavadovskaya, E. K.; Grishukov, V. A. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 46-49 (1974). (In Russian).

A study of the dielectric properties of the material T-8000 showed the difference in the action of protons and electrons on radiation-induced changes in dielectric penetrability and the tangent of the angle of dielectric losses. Irradiation with high-energy (4.5 MeV) protons is more probably accompanied by removal of Ti, zirconate, and Ba ions, than is irradiation with ≥1.2 MeV electrons. (tr-auth)

16223 INVESTIGATION OF PHASE STABILITY IN THE $Y_2O_3-Al_2O_3$ SYSTEM. Abell, J. S. (Birmingham Univ., Eng.); Harris, I. R.; Cockayne, B.; Lent, B. (Birmingham Univ., Eng.). J. Mater. Sci.; 9: No. 4, 527-537(Apr 1974).

The stability of the three known phases in the $Y_2O_3-Al_2O_3$ pseudo-binary system was investigated. $YAlO_3$(YAP) and $Y_4Al_2O_9$ (YAM) decompose at elevated temperatures, the products of the reaction being the third compound $Y_3Al_5O_{12}$(YAG) and an unknown phase (designated X). The decomposition is most evident in powders but can also be initiated on the surface of bulk single crystals. X-ray diffraction studies were performed in an attempt to identify the structure and composition of the unknown phase. The thermal decomposition has been found to be surface controlled and an optical and scanning electron microscope study of the associated morphological changes in $YAlO_3$ indicates that the reaction involves localized surface melting, probably with the loss of oxygen which effectively moves the composition off the binary join. (auth)

16224 PREPARATION, PHASE RELATIONSHIPS, AND Eu-151 MOESSBAUER SPECTROSCOPY OF EUROPIUM TUNGSTEN BRONZES AND RELATED PHASES. Dimbylow, C. S. (Univ. of Bradford, Eng.); McColm, I. J.; Barton, C. M. P.; Greenwood, N. N.; Turner, G. E. J. Solid State Chem.; 10: No. 2, 128-136(Jun 1974).

Crystal chemistry and phase relations for the bronze-forming region of the Eu−W−O system were investigated. A bronze Eu_xWO_3 is stable up to 1000°C when $x \leq 0.125$ and in the region $0.085 \leq x \leq 0.125$ the symmetry is cubic. A tetragonal bronze exists at $x = 0.05$, and an orthorhombic bronze with a structure closely related to the orthorhombic form of WO_3 exists below $x = 0.01$. Moessbauer spectra at room temperature and at 80°K indicate that in all these phases the europium is highly ionized as Eu(III) with no electron localization to give Eu(II) even at low values for x. The decomposition products of the bronzes have been established, and the Moessbauer parameters for the highly nonstoichiometric tungstates Eu_xWO_4 were determined. Both Eu(II) and Eu(III) resonances were obtained, and a cation vacancy model for Eu_xWO_4 was found to fit the data best. In conformity with the foregoing data, a sample of composition "$Eu_2W_2O_7$" was found not to be a pyrochlore but to comprise a mixture of Eu_6WO_{12}, Eu_xWO_4, and W. The phase relationships for the europium bronze system Eu_xWO_3 are compared with those of other ionic bronzes Na_xWO_3, Li_xWO_3, and Al_xWO_3. (auth)

16225 ELECTRICAL CONDUCTIVITY AND DEFECT STRUCTURE OF Nd_2O_{3+x}. Naito, K.; Tsuji, T.; Une, K. (Nagoya Univ., Japan). J. Solid State Chem.; 10: No. 2, 109-115(Jun 1974).

The electrical conductivity and departure from the stoichiometry of Nd_2O_3 were measured over the temperature range of 900 to 1100°C and oxygen partial pressure of 1 to 10^{-19} atm. The hole conductivity of Nd_2O_3 is found to be proportional to $P_{O_2}^{1/n}$, where n are 4.6, 4.9, and 5.1 at 900, 1000, and 1100°C, respectively. From the oxygen partial pressure dependence of the hole conductivity, it is shown that the predominant point defects in nonstoichiometric $NdO_{1.5+x}$ are fully ionized and partially doubly ionized metal

vacancies. From the thermogravimetric measurements, the departure from stoichiometry, x in $NdO_{1.5+x}$, is 2.0×10^{-3} at 1000°C and 1 atm. By combining the electrical conductivity and weight change data, it is shown that the hole mobility is 6.3×10^{-4} (cm^2/V · sec) at 1000°C and 1 atm. (7 figures) (auth)

16226 STRUCTURAL VARIATION IN THE $Y_{3-c}Pr_cScFe_4O_{12}$ GARNET SYSTEM. Dernier, P. D.; Gyorgy, E. M.; Grodkiewicz, W. H. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Solid State Chem.; 10: No. 2, 122-127(Jun 1974).

Structural refinements from single crystal x-ray diffraction data of four members of the garnet series, $Y_{3-c}Pr_cScFe_4O_{12}$, have revealed a nonlinear variation in oxygen positional coordinates versus Pr concentration. As a result of this anomaly the various polyhedra in the cubic unit cell expand and contract in an interdependent fashion such that the lattice parameter, a_0, varies nearly linearly with concentration. This finding is related to recent magnetic anisotropy measurements as well as the crystal chemistry of the garnets in general. (auth)

16227 REPRODUCIBLE GARNET FILM PREPARATION USING FAST GROWTH RATES. Bonner, W. A. (Bell Telephone Labs., Inc., Murray Hill, NJ). Mater. Res. Bull.; 9: No. 7, 885-894(Jul 1974).

Large numbers of uniform defect-free magnetic garnet films having essentially identical properties can be prepared from the same melt using conventional LPE dipping techniques when growth rates of 2-4 μm/min are employed. Such fast growth rates suppress compositional drift in successive films and avoid second-phase precipitation. Data is given for 40 highly perfect films (>1 cm^2, $4\pi M_s$ = ~200 gauss) grown sequentially from the same melt. Melt composition and growth conditions necessary to achieve fast growth are discussed. (8 figures) (auth)

16228 STRUCTURAL INVESTIGATION OF THE METAL-INSULATOR TRANSITION IN V_6O_{13}. Dernier, P. D. (Bell Telephone Labs., Inc., Murray Hill, NJ). Mater. Res. Bull.; 9: No. 7, 955-964(Jul 1974).

The metal-insulator transition in V_6O_{13} (~150°K) is accompanied by a structural distortion involving a decrease in symmetry from the centric space group C 2/m to the acentric group C2. The displacements of certain ions clearly reveal a redistribution of effective charge over the three inequivalent cation sites. From an analysis of V-O bond lengths in the insulating structure at 120°K, it appears that the V(1) ions become more V^{3+}-like while the V(2) and V(3) ions in a compensating manner become more V^{4+}-like. In contrast to the low-temperature insulating structures such as V_4O_7 and VO_2, no anomalously short V-V separations were observed in V_6O_{13} at 120°K. (auth)

16229 FORMATION OF ZIRCONIUM TUNGSTEN BRONZES OF THE PEROVSKITE TYPE. Ekstroem, T. (Univ. of Stockholm); Tilley, R. J. D. Mater. Res. Bull.; 9: No. 7, 999-1006 (Jul 1974).

The oxygen-rich corner of the ZrO_2-WO_3-WO_2 system was studied by means of x-ray powder diffraction and electron microscopy at room temperature of specimens quenched from the preparation temperatures of 1000 and 1100°C. Zirconium tungsten bronzes of formula Zr_xWO_3 are formed for $0 < x < 0.075$. The symmetry of the unit cell increases with rising zirconium content x from monoclinic through orthorhombic to tetragonal (pseudo-cubic) at approximate x-values of 0.027 and 0.047, respectively. The zirconium atoms enter the empty cages in the tungsten trioxide structure in the same manner as for tungsten bronzes of the perovskite type. No evidence was observed for the formation of any crystallographic shear planes in these bronzes. (auth)

16230 ROLE OF CORRELATION EFFECTS IN NARROW BAND SOLIDS: MAGNETISM AND THE METAL-INSULATOR TRANSITION. Kimball, J. C. (Louisiana State Univ., Baton Rouge); Schrieffer, J. R. pp 21-32 of Magnetism in Alloys. Beck, P. A. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1972).

From magnetism in alloys symposium; Boston, Massachusetts, USA (10 May 1972). See CONF-7205109-.

The role of electron-electron correlation effects in determining the thermodynamic magnetic and transport properties of narrow band solids is discussed within the context of the Hubbard model and generalizations of this model. Recent theoretical advances based on the functional average method have shown that the phase diagram of systems in which the relative importance of energy band and intra-atomic Coulomb interactions can be varied is one showing a sharp transition between a paramagnetic metal and an antiferromagnetic metal or semiconductor. In addition, the Hubbard model gives no sharp transition between the paramagnetic metal and paramagnetic semiconductor phases in contrast with a first order transition line observed experimentally, say in V_2O_3, ending in a critical point. It appears that the discrepancy is due to the importance of lattice distortion at the transition and a generalized Hubbard model including dilatation effects is discussed. (auth)

16231 CERIUM-NITROGEN-OXYGEN SYSTEM. Oxygen as a Component in the Binary Ce-N System at 950°C. Brown, R. C.; Clark, N. J. (Flinders Univ., Bedford Park, South Australia). Mater. Res. Bull.; 9: No. 7, 1007-1016(Jul 1974).

Cerium nitride prepared by reacting the metal with nitrogen at 795°C is inhomogeneous with an outer nitride layer surrounding a core of cerium oxynitride. Long annealing at 950°C produces a homogeneous product. The variation of the lattice parameter of the cerium nitride in two-phase cerium nitride-metal mixtures indicates the system must be considered as ternary with oxygen as the third component. The literature value of 5.0235 Å for the lattice parameter of CeN is believed to refer to a low-oxygen-content substoichiometric nitride and extrapolation predicts 5.020 Å as the lattice parameter of oxygen-free, stoichiometric CeN. (auth)

16232 HIGH VOLTAGE ELECTRON MICROSCOPY OBSERVATION OF DEFECTS AT THE INTERFACE OF Ni-NbC COMPOSITES. Martin, J. L. pp 264-267 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From 3rd international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

Interfaces between fiber and matrix in Ni-NbC composites are characterized by a mismatch of 24%. These types of interfaces have been observed to obtain a better understanding of their role in the plastic deformation of such compounds, which are being studied because of their competitive mechanical properties at high temperatures. These composite materials are obtained by directional solidification of eutectic alloys, and consist of a nickel matrix reinforced by niobium carbide fibers. Using HVEM, interfaces between fibers and matrix were studied and are shown. Dislocations are present in the matrix as a result of plastic deformation that occurred during the cooling of the alloy or foil preparation. In the fibers, on the contrary, dislocations are seldom seen. Each interface has a network of at least two families of straight defects. The network observed at the fiber matrix interface cannot be associated with misfit dislocations. Indeed, such a boundary can be described, at least formally, as a set of primary dislocations (one every four planes in the nickel matrix, for instance) together with secondary dislocations possibly, this accounting for the fact that the mismatch is not exactly 25 per cent. A possible way of interpreting this defect network would be to consider it as being formed during the cooling of the specimen, when the slip dislocations move from the fiber toward the matrix. To test this interpretation, the behavior of the interface network is being observed in the microscope while the specimen undergoes temperature variations. (UK)

16233 HIGH VOLTAGE ELECTRON MICROSCOPY OF OXIDE CERAMICS. Mitchell, T. E.; Heuer, A. H. pp 327-331 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From 3rd international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

The application of HVEM to the study of dislocation substructures in deformed spinel ($MgAl_2O_4$) and sapphire (Al_2O_3), spinodal decomposition in TiO_2-SnO_2, and precipitation in sapphire, spinel, and zirconia (ZrO_2) is described. All work was performed on a Hitachi HU-650B high voltage electron microscope operating at 650 kV. (UK)

16234 STUDIES OF RADIATION DAMAGE IN CRYSTALLINE MATERIALS BY MEANS OF HIGH VOLTAGE ELECTRON MICROSCOPY. Wilkens, M.; Urban, K. pp 332-340 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From 3rd international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

Work on radiation damage studies in crystals, using the HVEM, is reviewed. Considering irradiation at temperatures where vacancies and interstitials are mobile by thermal diffusion, includes work on steady-state defect concentrations, interaction of point defects with dislocations and the formation of voids. Irradiation at temperatures where the thermal mobility of vacancies can be neglected indicates that the loop density reaches a stationary value after a very short time followed by a period of continuous loop-growth. Work on radiation damage at low temperatures, order-disorder reactions in alloys, determination of the threshold voltage and the study of displacement damage in semi-conductors are considered. (UK)

Metals and Alloys

Refer also to abstracts 15351 and 16144.

16235 (CONF-700347-) HEAVY SECTION STEEL TECHNOLOGY PROGRAM. Fourth Annual Information Meeting, March 31–April 1, 1970. (Oak Ridge National Lab., Tenn. (USA)). 1970. 463p. Dep. NTIS $26.25.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

A total of 34 papers was presented at the conference. Four of these were unavailable for publishing in the proceedings. One paper was previously abstracted in NSA. A separate abstract was prepared for each of 29 papers. (JRD)

For abstracts of individual papers see: 15341–15344, 16252, 16278–16295, 16386–16390, and 16455.

16236 (INIS-mf-973) INVESTIGATIONS OF ZIRCONIUM ALLOYS. Castaldelli, L.; Fizzotti, C.; Masperoni, A. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Oct 1972. 10p. INIS.

From 2nd Italian-Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

In the Cirene prototype reactor, Zircaloy-2 has been choosen as a reference material for cladding and pressure tubes. Several investigations were performed in the fields of fabrication, corrosion, mechanical properties, welding, and physical metallurgy of zirconium alloys. Some of the activities now in progress on the corrosion in water, steam, and other environments and on physical metallurgy of zirconium alloys are presented and discussed. A few zirconium alloys were taken into consideration to compare with the Zircaloy-2 reference alloy. (auth)

16237 TITANIUM–BERYLLIUM MICROCOMPOSITES. A State-of-the-Art Review. Isserow, S.; Rizzitano, F. J. (Army Materials and Mechanics Research Center, Watertown, MA). Composites; 5: No. 4, 145-150(Jul 1974).

Ti–Be composites were developed over a broad range of compositions to take advantage of the low density and high modulus of the beryllium and the strength and toughness of the titanium. Standard metal-working methods can be used for preparation of these fiber-reinforced composites from powder blends (hence the designation, microcomposites) and also for subsequent processing to finished components. A review is presented of the development of these materials. Potential applications are indicated. (auth)

Corrosion and Erosion

Refer also to abstracts 17695 and 17743.

16238 (K-1860) APPLICATION OF EDDY CURRENTS TO DETECT CORROSION IN COPPER AND STAINLESS STEEL TUBING. Smith, J. H. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 53p. Dep. NTIS $5.45.

The ability of an eddy-current test to detect and evaluate corrosion in heat exchanger tubing is investigated. Two types of tubing are considered; a finned copper tubing used in a water-cooled Freon condenser and a straight-wall cylindrical stainless steel tubing used in a Freon-Freon heat exchanger. The resolution and sensitivity of these tests are determined and the testing techniques, instrumentation, and theory of the test are discussed. A relationship is shown between the eddy-current indications obtained from drilled through holes and indications obtained from corrosion pits. (auth)

16239 (N-74-15388) COMPATIBILITY OF REFRACTORY MATERIALS FOR NUCLEAR REACTOR POISON CONTROL SYSTEMS. Sinclair, J. H. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jan 1974. 38p. (NASA-TM-X-2963; E-7581). NTIS $3.00.

Metal-clad poison rods have been considered for the control system of an advanced space power reactor concept studied at the NASA Lewis Research Center. Such control rods may be required to operate at temperatures of about 1400°C. Selected poison materials (including boron carbide and the diborides of zirconium, hafnium, and tantalum) were subjected to 1000-hour screening tests in contact with candidate refractory metal cladding materials (including tungsten and alloys of tantalum, niobium, and molybdenum) to assess the compatibility of these materials combinations at the temperatures of interest. Zirconium and hafnium diborides were compatible with refractory metals at 1400°C, but boron carbide and tantalum diboride reacted with the refractory metals at this temperature. Zirconium diboride also showed promise as a reaction barrier between boron carbide and tungsten. (STAR)

16240 (N-74-16614) OUTER SKIN PROTECTION OF COLUMBIUM THERMAL PROTECTION SYSTEM (TPS) PANELS. Final Technical Report. Culp, J. D. (McDonnell-Douglas Astronautics Co., St. Louis, Mo. (USA)). Sep 1973. Contract NAS3-15546. 129p. (NASA-CR-134535; MDC-E-913). NTIS $8.50.

A coated Nb alloy material system 0.04 cm thick was developed which provides for increased reliability to the load-bearing character of the system in the event of physical damage to and loss of the exterior protective coating. The increased reliability to the load-bearing Nb alloy (FS-85) was achieved by interposing an oxidation-resistant Nb alloy (B-1) between the FS-85 alloy and a fused slurry silicide coating. The B-1 alloy was applied as a cladding to the FS-85 and the composite was fused slurry silicide coated. Results of material evaluation testing included cyclic oxidation testing of specimens with intentional coating defects, tensile testing of several material combinations exposed to reentry profile conditions, and emittance testing after cycling of up to 100 simulated reentries. The clad material, which was shown to provide greater reliability than unclad materials, holds significant promise for use in the thermal protection system of hypersonic reentry vehicles. (auth)

16241 OXYGEN METER EVIDENCE OF DOUBLE-OXIDE-CONTROLLED OXYGEN ACTIVITY IN SODIUM. Grundy, B. R. (Westinghouse Electric Corp., Madison). Trans. Amer. Nucl. Soc.; 18: 101-102(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16242 ASSESSMENT OF WATER–SIDE CORROSION PROBLEMS IN FERRITIC STEEL LMFBR STEAM GENERATORS. Isaacs, H. S. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 116-117(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16243 DEVELOPMENT OF DUPLEX TUBING FOR NUCLEAR STEAM GENERATORS. Sessions, C. E.; Harman, D. G.; Kindell, W. H. (Westinghouse Electric Corp., Tampa, FL). Trans. Amer. Nucl. Soc.; 18: 117-118(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16244 CADMIUM EMBRITTLEMENT OF HIGH STRENGTH, LOW ALLOY STEELS AT ELEVATED TEMPERATURES. Hildebrand, J. F. Mater. Protect. Performance; 12: No. 9, 35-40(Sep 1973).

Tests were conducted to determine the lower temperature limit at which Cd embrittlement might occur on D6ac, AISI 4340 and maraging 200 steels, candidate materials for supersonic aircraft. Also, the tests attempted to distinguish between Cd and H embrittlement. Tests confirmed an embrittlement of D6ac at 480°F and indicated embrittlement at 420, 325, 300, and possibly even at 250°F. Specimens notched but not plated were loaded at room temperature and at 325°F to test the theory that H had caused the cracks. None of these failed or cracked. Three specimens from each of the three steels were vacuum metallized with Cd and exposed at 325°F. After a minimum of 100 h, only one maraging steel specimen exhibited cracks to a macroscopic examination. Subsequent exposures at 400 or 450°F resulted in a failure of the AISI 4340 and intergranular cracking of the D6ac steel. With this evidence, there seems to be little doubt that Cd plating not only causes H embrittlement but also causes Cd embrittlement when a highly stressed steel part is exposed to a temperature of 325°F or above. (Metals Abstr.)

16245 CORROSION OF ZINC AND CADMIUM IN ACID SOLUTIONS OF MONOHYDRIC ALCOHOLS. Grigor'ev, V. P.; Ekilik, G. N.; Ekilik, V. V. Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 4, 577-580(1973). (In Russian).

Electrochemical measurements of corrosion currents were used to study the corrosion kinetics of Zn and Cd in HCl-containing aqueous and alcohol solutions, the alcohols being those in the series methanol–decanol. The corrosion rate of Cd was higher in the alcohol solutions than in the corresponding aqueous solutions, whereas that of Zn was the same in both types of system if the number of C atoms in the alcohol was 3 or 4. Corrosion rates for both metals in alcohol solutions fell as the hydrocarbon radical length increased, this reduction being attributed to a change from cathodic to a mixed anodic–cathodic control. In general, the solvent affects the activation energy of the corrosion process. In both types of solvent the process is in the H depolarization and, in the alcohols, both this process and the anodic process occur more easily than in the aqueous acid. (Metals Abstr.)

16246 FRETTING FATIGUE OF TITANIUM AND SOME TITANIUM ALLOYS IN A CORROSIVE ENVIRONMENT. Water-

house, R. B.; Dutta, M. K. Wear; 25: No. 2, 171-176(Aug 1973).

S/N curves determined for commercial purity Ti, Ti–2.5% Cu, and Ti–6%Al–4% V alloys in air and 1% NaCl solution with and without simultaneous fretting are described. Corrosion fatigue results in a decrease in the fatigue strength of the Ti and Ti–Al–V alloy; no change was observed in the case of the Ti–Cu alloy. In the presence of fretting all the alloys suffered a decrease in fatigue strength, of 60% in the case of Ti and Ti–Al–V alloy and 39% in the case of the Ti–Cu alloy. The results show that where an alloy depends upon an oxide layer to confer corrosion-resistance, fretting, by mechanically disrupting this film, produces a reduction in the fatigue strength. (Metals Abstr.)

16247 INTERACTIONS BETWEEN STRESSED ZIRCONIUM ALLOYS AND IODINE AT 300°C. Wood, J. C. (Atomic Energy of Canada Ltd., Chalk River). Nucl. Technol.; 23: No. 1, 63-79 (Jul 1974).

Various zirconium alloys were exposed to iodine vapor at 300°C under static tensile stress and marked differences in their cracking behaviors were observed. Some alloys that resisted cracking in iodine before irradiation became susceptible after receiving neutron fluences exceeding 2×10^{24} n/m^2, (E > 1 MeV) in the proximity of UO_2 fuel but not after irradiation to higher fluences in air. Control tests showed that fission products adhering to or implanted into the surfaces of irradiated tubing did not cause cracking in the absence of deliberately added iodine. Experiments confirmed the strong influence of residual stresses on the cracking of cold drawn unirradiated tubes under static applied stress. Treatments that decreased the tensile residual stresses (roller straightening, shot peening, and irradiation to a low fluence of fast neutrons) reduced the likelihood of stress corrosion cracking in iodine vapor. After Zircaloy has reacted chemically with iodine, the Zircaloy picks up hydrogen rapidly. It was also observed that hydrided Zircaloy has a higher resistance to iodine-induced cracking than unhydrided Zircaloy. Surface coatings of graphite and baked poly-dimethyl-siloxane grease that protect Zircaloy from iodine attack have been tested and are discussed here. (6 tables) (auth)

16248 OBSERVATIONS ON THE MARKER BEHAVIOR OF NOBLE GASES DURING THE ANODIC OXIDATION OF TANTALUM. Pringle, J. P. S. (Atomic Energy of Canada Ltd., Chalk River, Ontario). J. Electrochem. Soc.; 121: No. 7, 865-867 (Jul 1974).

Argon, krypton, xenon, and radon were used as markers for measuring the transport numbers of metal and oxygen during the anodic oxidation of tantalum. Within experimental error, the results are independent of marker concentration over five orders of magnitude, and so the markers do not influence the transport mechanism by their presence, or by any radiation damage accompanying their implantation. Neon behaves in the same way as the heavier gases and is thus also suitable as a marker. (auth)

16249 CERTAIN ASPECTS OF INTERACTION BETWEEN CLADDING STEELS AND SODIUM COOLANT. Ioltukhovskii, A. G. At. Energ. (USSR); 36: No. 4, 291-300(Apr 1974). (In Russian).

Various aspects of the behavior of stainless chromium-nickel steel in contact with sodium in the temperature range 500 to 800°C such as selective removal from the steel of components (Ni, Cr, Fe, Mn, C, N, etc.) the effects of testing conditions on this process, interaction between steels, and sodium impurities (C, N, O) etc. are examined. In addition it is shown that a variation in the chemical composition of austenitic steel as a result of removal of components is accompanied by the appearance of α-ferrite in the steel structure, accelerated precipitation of the σ-phase along the grain boundaries, and sodium penetration into a specimen, as well as by a sharp decrease of rupture strength in case of appreciable corrosion of steel or removal of carbon and nitrogen. In sodium with carbon or nitrogen impurities, steels are carburized or nitrided and their ductility is lowered. (7 figures) (auth)

16250 OXIDATION OF TUNGSTEN SINGLE CRYSTALS IN THE PRESENCE OF A HIGH-ELECTRIC FIELD. Okuyama, F. (Nagoya Inst. of Tech. (Japan)). Surf. Sci.; 42: No. 2, 441-452 (Apr 1974).

The effects of high-electric fields on oxidation of tungsten single crystals in 6×10^{-4} torr of oxygen at 1200-1500°K were studied by field emission and transmission electron microscopy. Exposure of field emitters to oxygen in the absence of a field resulted in the build-up of emitter tips. Oxidation under the application of a negative or positive field, on the other hand, involved plane faceting and formation of oxide crystallites. Plane faceting was recognized to occur on the {111} and the {112} regions, showing the facetings of the {111} and the {112} planes into the {110} planes, whereas, crystallite formation seemed to take place selectively on the {100} regions. It was suggested by field emission microscopy that negative fields have an additional effect which causes the growth of an oxide crystal on the {110} plane. Transmission electron microscopy of an emitter oxidized in a negative field actually revealed a tiny oxide crystal with a size of ~300 Å grown on the developed {110} plane. The crystal exhibited a triangular shadow image strongly indicating an external pyramid-like form. (auth)

Preparation and Fabrication

Refer also to abstract 16147.

16251 (AED-Conf-73-475-1) INFLUENCE OF HEAT TREATMENT ON MICROSTRUCTURE, TEXTURE AND MECHANICAL PROPERTIES OF SEMI-FINISHED ZIRCALOY. Dressler, G.; Richter, H. (Metallgesellschaft A. G., Frankfurt am Main (F.R. Germany). Metall-Lab.; Vereinigte Deutsche Metallwerke A. G., Duisburg (F.R. Germany)). 1973. 10p. (In German). INIS.

From symposium on thermal treatment of the Deutsche Gesellschaft fuer Metallkunde; Bad Nauheim, Germany (18 Oct 1973).

Starting from the microstructure composition at annealing and hot forming temperatures resulting from phase transformations and intermetallic precipitations, the most important aspects in the production of semi-finished Zircaloy are dealt with. Following the characterization of the cold-formed state, the possible changes due to heat treatment of the mechanical properties in connection with the recovery and recrystallization processes thus occurring, as well as the changes in texture are presented. The importance of the knowledge in practice is described with special consideration to the property variations on a large production scale. (INIS)

16252 (CONF-700347-, pp vp, Paper 1) FABRICATION PROCEDURES AND ACCEPTANCE DATA FOR A533 WELDS AND A 10-IN.-THICK A543 PLATE. Childress, C. E. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Most of the steels under investigation by the HSST Program are SA-533 grade B, class 1 or 2. To broaden the scope of the investigative effort, a 10-in.-thick SA-543 grade B plate was purchased. The full-size plate was austenitized, quenched, and tempered to class 1 properties. A portion of the plate was then removed and stress relieved. The remainder was reaustenitized, quenched, and tempered to class 2 properties. A portion of this material was removed and stress relieved. The remainder of the class 2 material was retempered to class 1. Mechanical testing of the individual plate segments showed that they had been tempered at too low a temperature to achieve the required tensile properties. Accordingly, the plate segments were retempered at a higher temperature. A complete fabrication history of the steel and the mechanical properties data are presented. One shielded-metal-arc and four submerged-arc weldments made from HSST plate 01 edge material have been completed. A brief review of the welding procedures and a rather comprehensive review of the test data are reported. Additionally, data are presented relative to an electroslag weldment. The top half of the fourth HSST plate (plate section 04A) originally was heat treated to obtain SA-533 grade B, class 2 properties; however, class 2 tensile properties were not achieved. The original tempering data and the resulting mechanical properties are presented, along with the subsequent retempering data and mechanical test results. To provide additional weldments for evaluation, a 6-in.-thick SA-533 grade B, class 1 plate was purchased, with phosphorus and sulfur, respectively, restricted to 0.012 and 0.015% max. The plate was cut into five segments and rejoined along the cut edges by submerged-arc welding. The vendor was directed to fabricate the weldments in strict accordance with the requirements for class A vessels as specified in Sect. III of the ASME Code for Nuclear Vessels. Fabrication data for the plate material and weldments are presented. (auth)

16253 (FOA-4-4581-A2) EQUIPMENT FOR MELTING AND CASTING OF PLUTONIUM IN A BOX. Amundin, C. O.; Norrbrand, G.; Ekbom, L. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). May 1974. 12p. (In Swedish). Dep. NTIS (US Sales Only) $4.00.

Two vacuum furnaces, one resistance heated and one high frequency heated, with appurtenant apparatus for laboratory preparation of plutonium castings are described. The hf furnace is operated with a 6 kW-unit. The experience with this furnace and its heating procedure has been very good. The melting and casting through bottom tapping is satisfactory. (SW)

16254 (N-73-24896) DEVELOPMENT OF BERYLLIUM HONEYCOMB SANDWICH COMPOSITE FOR STRUCTURAL AND OTHER RELATED APPLICATIONS. Final Report, 1 July 1967–27 February 1972. Vogan, J. W.; Grant, L. A. (Solar, San Diego,

Calif. (USA)). 27 Feb 1972. Contract NAS8-21215. 133p. (NASA-CR-130648; RDR-1550-12). NTIS $8.75.

The feasibility of fabricating large beryllium honeycomb panels was demonstrated. Both flat and curved sandwich structures were manufactured using practical, braze bonding techniques. The processes developed prove that metallurgically assembled beryllium honeycomb panels show decided potential where rigid, lightweight structures are required. Three panels, each 10 square feet in surface area, were fabricated and radiographically inspected to determine integrity. This examination revealed a 97% braze in the final panel. It is believed that ceramic dies for forming and brazing would facilitate the fabrication techniques for higher production rates. Ceramic dies would yield a lower thermal gradient in the panel during the braze cycle. This would eliminate the small amount of face sheet wrinkling present in the panels. Hot forming the various panel components demonstrated efficient manufacturing techniques for scaling up and producing large numbers of hot-formed beryllium components and panels. The beryllium honeycomb panel demonstrated very good vibrational loading characteristics under test with desirable damping characteristics. (auth)

16255 (N-73-32429) THERMAL EXPANSION METHOD FOR LINING TANTALUM ALLOY TUBING WITH TUNGSTEN. Watson, G. K.; Whittenberger, J. D.; Mattson, W. F. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Oct 1973. 26p. (NASA-TN-D-7426; E-7402). NTIS $3.00.

A differential-thermal expansion method was developed to line T-111 tubing with a tungsten diffusion barrier as part of a fuel element fabrication study for a space power nuclear reactor concept. This method uses a steel mandrel, which has a larger thermal expansion than T-111, to force the tungsten against the inside of the T-111 tube. Variables investigated include lining temperature, initial assembly gas size, and tube length. Linear integrity increased with increasing lining temperature and decreasing gap size. The method should have more general applicability where cylinders must be lined with a thin layer of a second material. (auth)

16256 (SLA-73-1075) SOLDERING LARGE AREA JOINTS IN VACUUM. Hof, G. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). May 1974. Contract AT(29-1)-789. 25p. Dep. NTIS $4.25.

A one-inch square solder joint with a minimum of voids and flux pockets was required for hybrid microcircuit to a KOVAR heat sink attachment for heat dissipation beyond ceramic substrate capability. Solder could not be fed into this particular joint by capillary action as is normally done. It was necessary to precoat joint surfaces with flux and preposition a 0.004 in. thick gold solder form. A vacuum atmosphere to aid removal of trapped air and flux gases, while flowing the solder by heating, was most successful in producing nearly void free and flux free joints. Solder alloys tested were Pb–In, Sn–Pb, and Au–Sn. (auth)

16257 (SLL-74-5001) CHEMICAL MILLING. Dini, J. W. (Sandia Labs., Livermore, Calif. (USA)). May 1974. Contract AT(29-1)-789. 88p. Dep. NTIS $7.50.

Chemical milling has been used to advantage in removing excess material and reducing overall weight of metal parts. It is a valuable complementary technique to conventional milling and machining methods and is particularly useful for removing metal from thin sections or from parts that are already shaped. Chemical milling is discussed generally, describing the process, its applications, advantages and limitations, chemical milling solutions, maskants, and various other aspects of the chemical milling process. The effectiveness of chemical milling of specific materials such as aluminum, beryllium, magnesium, titanium, steel, and stainless steel alloys is considered. Various chemical milling solution formulations are presented and effects on such factors as mechanical and fatigue properties are considered. (auth)

16258 (WCAP-8324) CONTROL OF DELTA FERRITE IN AUSTENITIC STAINLESS STEEL WELDMENTS. Enrietto, J. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). May 1974. 25p.

The hypothesis is made that control of initial weld metal chemistry and welding parameters is sufficient to ensure a minimum delta ferrite content (for minimizing hot cracking) in production austenitic stainless steel weldments. Preliminary data that confirm the hypothesis are presented, and future programs for further testing are described. (DLC)

16259 HISTORY OF EBWR MATERIALS AND FUEL ELEMENT DEVELOPMENT. Macherey, R. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 112-113(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16260 FABRICATION PROCEDURES FOR BERYLLIUM REINFORCED TITANIUM COMPOSITES. Goodwin, V. L. pp 374-378 of New Industries and Applications for Advanced Materials Technology. Azusa, CA; Society for Advancement of Material and Process Engineering (1974).

From new industries and applications for advanced materials technology symposium; Buena Park, California, USA (23 Apr 1974). See CONF-740437-.

Beryllium reinforced titanium matrix composites produced by the co-extrusion process are unique among contemporary composites in their metal-like fabricability. Basic shapes such as bars and tubes can be produced directly through extrusion. The ductility of the composite system is such that metal working operations including hot forming, rolling, drawing, and forging can be accomplished. The machinability of these composites parallels that of Ti(6Al–4V) in most respects. Discussions of fabrication methods and examples of fabricated components are presented. (auth)

16261 STRUCTURAL FABRICATION OF METAL–MATRIX COMPOSITES. Miller, M. F. (General Dynamics Corp., San Diego, CA). pp 417-423 of New Industries and Applications for Advanced Materials Technology. Azusa, CA; Society for Advancement of Material and Process Engineering (1974).

From new industries and applications for advanced materials technology symposium; Buena Park, California, USA (23 Apr 1974). See CONF-740437-.

Several significant metal-matrix airframe structures, measuring up to seven feet long, have been built using a combination of tape layup and modified sheet metal fabrication techniques. These structures (four of which are discussed) include a missile adapter, aircraft engine bulkhead, shear beam, several compression panels, a tubular truss, and landing gear drag struts. On the basis of the success of these structures, boron/aluminum is being considered for applications to the Space Shuttle. (auth)

16262 PREPARATION OF NIOBIUM–GERMANIUM COMPOUNDS FROM THE GAS PHASE. Petrusevich, I. V.; Nisel'son, L. A.; Valueva, N. A ; Kozlov, F. N. Nauch. Tr., Gos Nauch.-Issled. Proekt. Inst.; 42: 52-56(1972). (In Russian).

Nb–Ge compounds were prepared by the H reduction of $NbCl_5$ + $GeCl_4$ mixtures in the gas phase on heated surfaces, e.g., on a 1.0-mm dia 500-mm length of a U-shaped Mo wire. Under conditions of 1100°C, H 1.0 liters/min, Ar 0.1 liters/min, and the ratio H_2 : ($NbCl_5$ + $GeCl_4$) ≈ 9 : 1, the compounds Nb_3Ge_3 and Nb_3Ge_2 were obtained. Reducing the $GeCl_4$ content of the gas mixture reduced both the deposition rate and the yield of Nb, the latter being less affected. Rates and yields of Nb using horizontal reaction tubes were higher than those from vertical tubes. (Ref. Zh.)

16263 BRAZING OF NIOBIUM-BASE ALLOYS. Grishin, V. L. Svar. Proizv.; No. 1, 35(Jan 1973). (In Russian).

The evaporation rate and resistance to oxidation of the brazing alloys, and the interaction kinetics of the brazing alloys with the base metal were studied. Brazed joints of alloys VN2AEMP and VN5AEP with a shear strength comparable to that of the base metal were obtained. Data on brazing conditions and the composition of brazing alloys, are given. (Metal Abstr.)

16264 ALUMINOTHERMIC REDUCTION OF NIOBIUM PENTOXIDE. Ivanova, M. I.; Elyutin, A. V. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst.; 42: 116-122(1972). (In Russian).

The aluminothermic reduction $3Nb_2O_5 + 10Al \rightarrow 6Nb + 5Al_2O_3$, was studied to determine the optimum conditions for the process. An increase in the concentration of Al in the mixture would be expected to reduce the Nb content in the slag and the O in the metal, and with Al contents of 10 to 13%, the concentration of Nb in the slag was lowered to 0.3 to 0.2 wt. % at 2500°K. With small Al contents, the process temperature is below the mp of the metal, and the separation of the reaction products is hindered. With Al > 60%, less separation occurs, since the process temperature is below the slag mp. The calculated data were confirmed experimentally under laboratory conditions. (REFERATIVNYI ZH.)

16265 PROGRESS TOWARD A MORE WELDABLE A-286. Brooks, J. A.; Krenzer, R. W. (Sandia Labs., Livermore, CA). Weld. J. (N. Y.); 53: No. 6, 242-s-245-s(Jun 1974).

Results of a study concerned with high temperature phase equilibria in A-286 stainless steel and the role of the individual alloying elements on fusion zone (weld metal) cracking of A-286 are reported. Results also indicated that the composition of the high temperature grain boundary phase thought to be responsible for heat affected zone (HAZ) microfissuring in A-286 is more complex than that reported in the literature, and that a more weldable alloy can be achieved by minor adjustments in chemistry. (auth)

16266 FABRICATION OF CLADDING TUBES FOR FAST REACTOR FUELS. Lallemand, J. P. (Societe Vallourec,

Montbard, France). pp 323-338 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The fabrication of stainless steel cladding tubes for fast neutron reactors involves: hot working for transformation of the starting metal into a rough tubular block; initial cold operations for transforming the block into an intermediate-size tube for rolling; final cold transformation for imparting the required properties to the cladding tubes (by drawing and rolling). The desired product quality is achieved by making checks on the metal and taking appropriate care during all operations. Control of the final product, and in particular non-destructive control, is a means of ensuring that the products are in conformity with specifications. Several tens of kilometers of stainless steel cladding tubes fabricated in accordance with these techniques are operating in pile and exhibiting satisfactory behavior. (auth)

16267 WELDING OF AUSTENITIC STEEL CLADDING FOR FAST REACTOR FUEL PINS. Papeleux, P. (Belgonuclear, Brussels); Flipot, A. J.; Lafontaine, I. pp 339-355 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The austenitic steels intended for use in the SNR 300 reactor are stabilized with titanium, niobium, or vanadium. Their susceptibility to hot cracking during welding depends on their composition, the thermal welding regime applied, and the design of the bond. Owing to the separation of impurities and of certain alloy elements, there appear, during solidification, liquid phases with a low melting point and poor mechanical strength which cannot withstand severe shrinkage stresses. The solutions proposed thus aim at keeping such stresses as small as possible. A first approach, based on a relatively hot thermal welding cycle, was used on the solid inset plugs and reduced the severity of shrinkage stresses by slowing the rate of cooling of the fused metal. Shrinkage stresses were subsequently alleviated by the adoption of a bored-out plug. The stresses can be reduced, on the one hand, by limiting the shrinkage itself and, on the other hand, by deformability under weak stresses of the metal beneath the weld. Observations of deformation in solid and bored-out inset plugs have confirmed the superiority of the latter design, which has in fact been used for fast flux irradiation experiments. A plug end-welded onto the cladding has also been successfully tested as a means of reducing shrinkage stresses. (auth)

16268 MODERN DEVELOPMENTS IN POWDER METALLURGY. Volume 6. Applications and Processes. Proceedings of the 1973 International Conference Held at Toronto, Canada, July 15-20, 1973. Hausner, H. H.; Smith, W. E. (eds.). Princeton, NJ; Metal Powder Industries Federation (1974). 451p. (CONF-730718-P6). $35.00.

Twenty-eight papers presented at the conference are included in Volume 6. A separate abstract was prepared for each of six papers selected for inclusion in Nuclear Science Abstracts. (JRD)

For abstracts of individual papers see: 16269-16274.

16269 VIBROCOMPACTION OF HARD AND DISPERSED POWDERS. Rutkowski, W.; Wagner, T.; Wieczorkowski, M. (Inst. of Nuclear Research, Warsaw). pp 189-200 of Modern Developments in Powder Metallurgy. Vol. 6. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From fourth international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P6.

Results of investigations on vibration compaction of several ceramic and metallic powders are reported. Results of these experiments show that mixtures of powders of different specific density do not segregate during vibrocompaction and that their particle distribution is similar to that in conventionally pressed compacts; actually the vibrocompacted specimens are more homogeneous. At a height to diameter ratio greater than 5, the vibrocompacted specimens did not differ more than ± 3% in density along the height axis and not more than ± 1% in the diameter direction. The highest density-i.e. 75% of the theoretical density-was maintained, even for materials such as SiC and Al_2O_3, which are difficult to compact by conventional pressing. Plastic powders and blended mixtures can effectively vibrocompact. Vibrocompaction can be easily automated by using carefully selected particle sizes of the powders. (auth)

16270 CHEMICAL COMPACTING AND SINTERING. Nayar, H. S. (Airco, Inc., Murray Hill, NJ). pp 215-235 of Modern Developments in Powder Metallurgy. Vol. 6. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From fourth international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P6.

Results of studies on powder metallurgical processes are presented showing that chemical compacting and sintering (CCS) process yields relatively crack-free porous bodies with higher strength, relatively round interstitial pores, greater interparticle neck area, and higher ductility compared with conventional direct particle sintering (DPS) process. Shrinkage during the CCS process can be controlled over a wide range without sacrificing strength significantly. The DPS process generally results in micro-cracks (at locations where there were no contacts between neighboring particles prior to sintering) throughout the sintered porous body. This leads to non-uniform shrinkage on a micro scale throughout the porous body. Micro-cracks (and therefore the non-uniform shrinkage) are considerably reduced in the CCS process because of the "bridging" effect during the chemical compacting step of the CCS process. As a general rule, the CCS process can be carried out at relatively low temperatures compared with the DPS process in order to attain a given level of strength and/or density. The CCS process is applicable to particles of a variety of sizes, shapes, chemical compositions, and metallurgical states. The particles may be incompressible, unannealed, and of high alloy compositions with or without C, S, etc. Some of the impurities can be removed during the CCS processing. The CCS provides an opportunity to use low cost powders. The CCS process with modifications can be used to produce large powder metallurgy parts, forged parts, filters, and semi-finished wrought products of long lengths. The materials which can be processed may be single-phase, multi-phase, dispersion-strengthened, or precipitation-hardened alloys and composites. (auth)

16271 REEXAMINATION OF THE SINTERING PROCESS FOR FERROUS ALLOYS. Kaufman, S. M. (Ford Motor Co., Dearborn, MI). pp 265-273 of Modern Developments in Powder Metallurgy. Vol. 6. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From fourth international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P6.

Results of investigations are presented showing that master iron-base alloys incorporating the Fe-C eutectic reaction fulfill a need for materials that will alloy rapidly and completely during abbreviated sintering cycles and are compatible with existing equipment and practices. (JRD)

16272 STUDY OF THE PARTICULARITIES OF TWO-COMPONENT SYSTEM SINTERING. Fedorchenko, I. M.; Ivanova, I. I. pp 343-353 of Modern Developments in Powder Metallurgy. Vol. 6. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From fourth international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P6.

Powder mixtures consisting of Co-Ni, Fe-Cr, Fe-Si, Ni-Cr, Cu-Ni, and W-Mo were studied emphasizing shrinkage mechanisms associated with sintering. It was found that composition dependency of shrinkage in two component systems is determined by the concentration course of the diffusion coefficients. With the decrease of diffusion coefficients a decrease in shrinkage of the corresponding compound is generally noted (Fe-Cr, Ni-Cr, nickel base solid solutions) and vice versa, the increase of diffusion coefficient values results in an increase of shrinkage (Fe-Si, W-Mo, etc). It is impossible, however, to point out exactly which particular coefficients-partial or of reciprocal diffusion-are responsible for the shrinkage value, since at present there are very few double systems for which reliable concentration dependences of all diffusion parameters are known. The concentration course of shrinkage may only be suggested to correspond more exactly to the course of partial coefficients of the component diffusion than to the course of the mutual diffusion coefficient. In most cases there is no correlation between concentration dependences of shrinkage and activation energy of diffusion. When this correlation was observed (in the Co-Ni system) it was connected with the fact that the D_0 factor was changing insignificantly and the changes of the diffusion coefficients with the change of composition was practically determined only by the activation energy values. Perhaps this was taking place in the Cu-Ni system too, where some correlation between the concentration course of shrinkage and activation energy of diffusion was noted. (auth)

16273 ELECTROTRANSPORT DURING SINTERING OF METAL POWDERS. Kotschy, J. (Technical Univ., Warsaw). pp 355-367 of Modern Developments in Powder Metallurgy. Vol. 6. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From fourth international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P6.

Electrotransport as a physical method for activation of sintering processes is examined. It was found that under the action of dc of sufficiently high initial and final current density, samples of subsieve powders can reach the full physical density after sintering during about 60 minutes at temperatures far below the melting point. High speed steels sintered at temperatures near the melting point showed a visible carbide segregation and grain growth at the anode end. Carbides migrate towards the cathode and this effect manifests itself even during short-period sintering. This may be affected by electrotransport and by another current-induced effects, e.g. electrophoresis. During long-period sintering a pore concentration at the cathode end and a pronounced grain growth at the anode end appears. This phenomenon is more readily observed for powders having great specific surface, when sintered at a temperature of about 0.9Tm. The lower the sintering temperature, the less pronounced is the grain growth phenomenon. Fine-grained powders of Ni and CuSn10 sintered to final densities of about 75% of the theoretical value showed a high ductility resulting in the possibility of cold pressing and rolling into thin films with a high degree of cold work. Bismuth showed a wire texture after sintering under dc. (auth)

16274 SUPERSOLIDUS SINTERING. Lund, J. A.; Bala, S. R. (Univ. of British Columbia, Vancouver). pp 409-421 of Modern Developments in Powder Metallurgy. Vol. 6. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From fourth international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P6.

Supersolidus sintering occurs when a single-phase, solid solution powder is heated to a temperature between the solidus and the liquidus. Some liquid is produced, the amount and composition being determined by the sintering temperature. Investigations of supersolidus sintering with an Fe–0.9% C steel and a 50% nickel, 50% copper (cupro-nickel) alloy are described. The investigations were conducted to examine the role of the amount of liquid phase in determining the early rate and extent of sintering, and to describe the mechanisms of sintering with the aid of studies of the external and internal structures of sintered bodies. Data and information on sintering of these materials are presented. (JRD)

Properties, Structure, and Phase Studies

Refer also to abstracts 15341, 15342, 15344, 16230, 16234, 17013, 17689, and 17696.

16275 (ANL-8095) HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF SODIUM. Padilla, A. Jr. (Argonne National Lab., Ill. (USA)). Apr 1974. Contract W-31-109-Eng-38. 65p. Dep. NTIS $5.45.

A set of high-temperature thermodynamic properties for sodium in the two-phase and subcooled-liquid regions is predicted for the region between the low-temperature properties recommended by Golden and Tokar and the critical temperature. This set of high-temperature properties is recommended for consistent thermodynamic calculations in reactor-safety analyses involving sodium. The saturation properties determined are: vapor pressure, liquid and vapor density, liquid and vapor enthalpy, liquid and vapor entropy, liquid compressibility (adiabatic and isothermal), liquid thermal-expansion coefficient, and liquid specific heat (constant-pressure and constant-volume). The subcooled-liquid properties determined are: pressure, enthalpy, entropy, compressibility (adiabatic and isothermal), thermal-expansion coefficient, and specific heat (constant-pressure and constant-volume). (auth)

16276 (BNWL-tr-119) CALCULATION OF THE BINDING ENERGIES FOR DEFECT CLUSTERS. Dang Dinh Cung. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). 8 Jul 1974. Translation by E. R. Appleby of CEA-R-4500. 23p. Dep. NTIS $4.25.

Several models which are available are described: point defects (elastic, electronic contribution, atomic), interatomic potential, and crystal model. Calculation of the relaxation and of the energies is considered. Using the same interatomic potential model as R. A. Johnson, several calculations were made for several configurations of defects in alpha-iron. Results are given for six configurations or mono-interstitials, and divacancies and trivacancies. The probable configuration of the interstitial is crowdion; of trivacancy, 3V2; of divacancy, 2V2. The vacancies in the third, fifth, sixth, seventh, and ninth neighbor positions tend to be repelled. (DLC)

16277 (CEA-R-4542) PHASE TRANSFORMATIONS IN TITANIUM ALLOYS. I. Contribution to Study of Transformation Kinetics in Ti–6% Al–6% V–2% Sn Alloy. Klima, R.; Quemper, F.; Beauvais, C.; Roux, C.; Rapin, M.; Hocheid, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92–Montrouge (France)). May 1974. 65p. (In French). Dep. NTIS (US Sales Only) $6.25.

Studies performed on Ti 6% Al–6% V–2% Sn are introduced by a short presentation of a preliminary work on phase transformations in Ti 6% Al–4% V titanium alloy. Time-temperature-transformation curves about transformations of Ti 6% Al–6% V–2% Sn show that above 700°C, β (bcc) $\rightarrow \alpha$ (hcp) is the only active reaction. α' martensite appears below this temperature and until 600°C a double break down takes place: $\beta \rightarrow \alpha$ and $\alpha' \rightarrow \alpha + \beta$. Below 600°C, α' remains even after lengthened holdings. Below 500°C, a very important hardening is ascribed to ω phase precipitation. Systematic mechanical tests have allowed to establish relationship between mechanical properties and the most characteristic microstructures. (auth)

16278 (CONF-700347-, pp vp, Paper 2) CHARACTERIZATION OF HSST PLATES. Berggren, R. G.; Jones, T. N. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

All steels used in the HSST Program are to be characterized by fabrication history, mechanical properties, metallography, and chemical composition as a function of location within the plate or other product form. Characterization studies of HSST plate 01, a 12-in.-thick plate of ASTM A 533 grade B, class 1 steel, are essentially complete. Material from the top and bottom ingot ends, center, and two edges has been studied, as well as some material from a region between the center and bottom ingot end of the plate. Tensile tests were conducted at 75, 450, 550, and 650°F. The lowest strengths found were near the bottom ingot end of the plate. Charpy V-notch impact transition temperatures showed little variation from top to bottom ingot ends, varying only with distance from the plate surfaces. Drop-weight tests were conducted using all three recognized sizes of specimens. The central regions of HSST plates 02 and 03, also 12-in.-thick plates of ASTM A 533 grade B, class 1 steel, have been characterized, with other regions of these two plates yet to be studied. (auth)

16279 (CONF-700347-, pp vp, Paper 3) MECHANICAL PROPERTIES OF THICK-SECTION WELDMENTS. Canonico, D. A.; Stelzman, W. J.; Berggren, R. G. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Studies to characterize welds representative of those employed in the fabrication of nuclear pressure vessels have continued. Electroslag (ES) weld metal and heat-affected zone were studied. The ES weld metal is somewhat poorer than the base metal. The weld metal showed no surface-to-center variation in Charpy V or tensile properties. This was surprising in view of the fact that electroslag weldments are given a postweld double-austenitize, double-quench, and temper heat treatment. The weld metal 30-ft-lb Charpy V temperature was about –20°F, and its shelf energy is about 80 ft-lb. These properties are in contrast to the properties of the 6-in.-thick ASTM A302 grade B, Code Case 1339, Mn–Mo base metal. The base metal 30-ft-lb Charpy V temperature was about –120°F and about 0°F for the surface and ¼-thickness locations respectively. The base metal shelf energy is in excess of 120 ft-lb. Though-the-thickness variations in the tensile properties of the base metal were noted. Studies of the heat-affected zone have shown this area to possess Charpy V properties similar to those of the base metal. A shielded-metal-arc (SMA) weld is under investigation. Data indicate that its properties are similar to those of the submerged-arc weld. The 30-ft-lb Charpy V temperature reported by the fabricator is about –75°F for the weld metal. Its shelf energy is about 150 ft-lb. The NDT of the weld metal was established at –60°F through a P-2 drop-weight test series. (auth)

16280 (CONF-700347-, pp vp, Paper 4) MICROSTRUCTURAL INVESTIGATIONS OF ASTM A533, GRADE B, CLASS 1 STEEL (HSST PLATE 01). Hester, J. R. Jr.; Brooks, C. R. (Univ. of Tennessee, Knoxville). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

A detailed microstructural study of the surface, quarter-thickness (¼ T), and center of the HSST program plate 01-K is reported. Results of optical and replica electron microscopy of polished and etched specimens, replica electron fractography of the surfaces of impact specimens, and direct observation of the fine structure (e.g., dislocation arrangements, carbide morphology) using transmission electron microscopy are emphasized. The interpretation of the microstructure was complicated, since all observations had to be made on the final heat-treated material (quenched and tempered), no as-quenched material being available. Optical microscopy showed that the microstructure at the surface

consists of bainite and clear regions which appear to be primary ferrite. However, electron metallography revealed that the clear regions contain carbides; these regions were found to be granular bainite. Thus, the surface consists of upper bainite and granular bainite, both having a high dislocation density. The ¼-T section consists almost wholly of granular bainite with a small amount of upper bainite, again with a high dislocation density being present in both. Generally, the structure is coarser than the surface. The center is very similar to the ¼-T section. The prior austenite grain size is ASTM 7 to 8 at all three levels. The surface of plate 01-K has an NDT 150°F lower than the ¼-T or center and 20% higher yield strength. The main contribution to these differences appears to be a finer bainite structure, in terms of the ferrite matrix and the carbide distribution, at the surface. (auth)

16281 (CONF-700347-, pp vp, Paper 6) FATIGUE CRACK GROWTH CHARACTERISTICS OF NUCLEAR PRESSURE VESSEL GRADE MATERIALS. Mager, T. R. (Westinghouse Electric Corp., Pittsburgh). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

While the termination of the life of structures or components may be based on the critical flaw size for large-scale rupture, it must be recognized that the total useful life of a cyclic-loaded component such as a reactor pressure vessel is dependent upon the rate of growth of flaws from a subcritical size to a critical size. Therefore, an understanding of the crack growth characteristics of the required reactor pressure vessel grade materials under application conditions is essential to determining the useful life of the vessel. Fatigue crack growth propagation depends upon the temperature, the environment, and the stress at the crack tip. Since the stress conditions can be adequately described by the stress intensity factor K (fracture mechanics parameter), the crack growth may be expressed as $da/dN = C(\Delta K)^n$. Using the fracture mechanics approach, the effect of an environment of high-temperature primary reactor grade water on the fatigue crack growth characteristics of nuclear pressure vessel grade materials was studied. The fatigue crack growth rate da/dN was measured as a function of ΔK, the change in the stress intensity factor at the tip of the crack. Tests were run utilizing 2T WOL (wedge opening loading) specimens at 550°F in an environment (excluding irradiation) typical of pressurized-water reactors and boiling-water reactors. Under the above conditions, the fatigue crack growth data acquired to date will be presented. In addition, fatigue crack growth rate data obtained in air on A 533 grade B, class 1 base plate and weldment material will be presented. These data have been published previously. (auth)

16282 (CONF-700347-, pp vp, Paper 7) PROPERTIES OF NUCLEAR GRADE FORGING STEELS. Cerjak, H.; Debray, W. (Siemens Aktiengesellschaft, Erlangen, Ger.). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

For all parts of Siemens PWR vessels, forged rings and plates have been used utilizing the steel 22 NiMoCr 37 exclusively which corresponds to the steel ASTM A 508 class 2. The main differences between our specification and the ASTM standard in the chemical composition for this type of steel are the limitation of the carbon content, and for large cross sections, an increase of the Ni content up to 1.3% to improve the effects of heat treatment in the center of the forgings. The requirements of the mechanical properties of the steel NiMoCr 37 are determined in agreement with the government authorities on the basis of statistical analyses of previous tests of this steel. Results are given on: tensile tests at room temperature and design temperature, impact tests and drop weight tests on samples taken longitudinally and transversely to the forging direction, and a comparison of the NDT temperature determined by drop weight tests and impact tests. In addition, results are given of mechanical properties as a function of the position of the samples in the wall on original PWR vessel parts and large test forgings. These results show that the tensile properties and elongations are constant along the cross section, whereas the impact and NDT properties deteriorate strongly with the distance of the test specimen from the quenching surface. (auth)

16283 (CONF-700347-, pp vp, Paper 8) FRACTURE MECHANICS TASKS OF THE HSST PROGRAM. Merkle, J. G. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The Fracture Mechanics Task of the HSST Program is a series of closely related investigations aimed at providing a more quantitative basis for fracture prevention and safety analysis for nuclear power plant primary containment systems. Design against fracture involves design against initiation for a flaw residing in good material and design for arrest for a flaw attempting to propagate out of a region of local embrittlement. Measurements of the dynamic fracture toughness K_{Id} and the crack arrest toughness K_{Ia} are being made to support these objectives. The strengths of nuclear pressure vessels are estimated conservatively, assuming that all parts of a vessel have the plastic strain capacity to reach their calculated limit conditions even in the presence of flaws of limited size. Elastic-plastic stress analyses and gross-strain-at-fracture measurements are being made to confirm these assumptions. (auth)

16284 (CONF-700347-, pp vp, Paper 9) FRACTURE TOUGHNESS CHARACTERIZATION OF VARIOUS PLATES OF MATERIAL FROM THE HSST PROGRAM. Mager, T. R. (Westinghouse Electric Corp., Pittsburgh). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Fracture mechanics was utilized to characterize the various HSST plate materials as a function of location throughout the thickness, length, and breadth of the material. The fracture toughness K_{Ic} of HSST plates 01, 02, and 03 was determined utilizing 1-in.-thick compact K_{Ic} specimens (1T). Specimens were taken at selective positions through the thickness of the plates. Because available data from HSST plate 02 indicated that valid K_{Ic} data could be obtained with 1T specimens at −150°F, all testing utilizing 1-in.-thick specimens was performed at −150°F. The main body of data represented longitudinal tests. However, additional tests were incorporated to study the effects of orientation of the notch with the primary working direction on the fracture toughness. It appears that the fracture toughness is essentially the same for all three plates and is independent of specimen orientation. In addition to 1T compact K_{Ic} specimens, several 4-in.-thick specimens (4T) fabricated from the center region of HSST plates 01 and 03 were evaluated. The 4T compact K_{Ic} specimens were tested at +10°F. The resulting fracture toughness data are compared with fracture toughness data previously reported for HSST plate 02. The limited number of 4T compact K_{Ic} specimens tested also indicated that plates 01, 02, and 03 were of the same toughness. (auth)

16285 (CONF-700347-, pp vp, Paper 10) SPECIMEN CRACK PREPARATION. Mager, T. R. (Westinghouse Electric Corp., Pittsburgh). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

It is generally known that a characteristic crack radius is associated with the critical stress intensity factor for onset of plane strain crack instability. To explore the possible effects of crack preparation on the measured values of fracture toughness K_{Ic}, the effect of prefatigue cracking stress levels, environmental conditions (stress corrosion), and initiation in a brittle weld (electron beam) were investigated. All testing was performed utilizing 1T compact K_{Ic} specimens fabricated from the center region of HSST plate 02. Presence of a corrosive environment did not appear to affect the K_{Ic} values. However, it appears that fatigue precracking levels are indeed a factor in determining the fracture toughness K_{Ic}. The advantage of crack preparation utilizing an electron beam weldment as a starter crack is discussed. (auth)

16286 (CONF-700347-, pp vp, Paper 11) RATE EFFECT STUDIES ON A533, GRADE B, CLASS 1 STEEL. Shabbits, W. (Westinghouse Electric Corp., Pittsburgh). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The dynamic fracture toughness properties of A 533 grade B, class 1 steel plate (HSST plate 02) are presented for loading rates ($K \cong 10^4$ ksi $\sqrt{\text{in.}}$ sec^{-1}) in the millisecond time range. Initial work involved investigation of the vibration and inertia problems as well as the instrumentation characteristics required to adequately resolve the dynamic fracture toughness behavior of compact tension test specimens up to 4 in. thick. A pneumatic-hydraulic open loop system was designed, and a number of test procedures were evaluated using strain gage instrumentation. Compact tension specimens 8 in. thick were tested using a gas-driven extrusion machine. A description of the test techniques and the interpretation as well as the practical limitations of dynamic fracture toughness testing are given. The results indicate rate effects in the form of reduced toughness level at all the test temperatures. The apparent overall effect is a shift of the static fracture toughness curve to higher temperatures where high fracture toughness K_{Ic} is shown for dynamic load conditions. (auth)

16287 (CONF-700347-, pp vp, Paper 12) STRAIN RATE AND CRACK ARREST STUDIES. Crosley, P. B.; Ripling, E. J. (Materials Research Lab., Glenwood, IL). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Crack initiation and crack arrest toughness of the HSST plates of A 533 steel were measured. At −70°F there was little difference between static initiation, dynamic initiation, and crack arrest toughness of 40 to 45 ksi $\sqrt{in.}$ At 0°F dynamic initiation and crack arrest toughness values were both of the order of 60 ksi $\sqrt{in.}$ Static initiation values were generally higher, ranging to above 80 ksi $\sqrt{in.}$ Initiation toughness values could be altered by changing the fatigue precracking procedure or prestressing a specimen prior to testing; the arrest toughness was not sensitive to these changes. It seems likely that at higher temperatures the arrest toughness would be distinctly lower than the dynamic initiation toughness; a few tests run at room temperature are consistent with this possibility. (auth)

16288 (CONF-700347-, pp vp, Paper 13) GROSS STRAIN CRACK TOLERANCE OF STEELS. Randall, P. N. (TRW Systems Group, Redondo Beach, CA). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Development of a measure of fracture toughness that can be used in a quantitative procedure for design against brittle fracture when the objective is to ensure yielding before fracture in the presence of the maximum expected flaw size is described. The approach was to measure gross (nonlocal) strain in a surface-cracked tensile specimen as a function of crack size and temperature. The best measure of fracture toughness was found to be the strain to maximum load, measured in the gross section above or below the crack. From test results to date, it appears that increasing crack depth 50% (from 0.05 to 0.38 in.) in geometrically similar specimens raised the transition temperature about 40°F. Requirements for specimen size to provide maximum constraint were found to be: thickness ≥2.5 × (crack depth) and width ≥3.0 × (crack length). These tentative values are based on the criterion that further increases produced no reduction in crack opening displacement (C.O.D.) at maximum load at any test temperature. Critical C.O.D. values and critical gross strain values measured in both the net and gross sections underwent an upward transition at some temperature, which was dependent on crack size and constraint. It is significant, however, that this was the temperature at which yielding occurred in the gross (not the net) section. Apparently, gross section yielding is required to relieve constraint fully. Furthermore, midplate material, which had a pronounced yield point, showed a much sharper transition than did material taken 2.0 to 3.5 in. from the plate surface, which had a smooth stress-strain curve. Follow-on work is planned to confirm these tentative conclusions about the method of measurement of gross strain. Then the effects of crack size on both transition temperature and on critical gross strain at a given temperature will be studied further to provide the basis for a quantitative design procedure. (auth)

16289 (CONF-700347-, pp vp, Paper 14) DEVELOPMENT OF FINITE ELEMENT COMPUTATIONAL METHODS FOR THREE-DIMENSIONAL ELASTIC-PLASTIC CRACK ANALYSIS. Levy, N.; Marcal, P. V.; Rice, J. R. (Brown Univ., Providence, RI). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

A description is given of the large-scale, three-dimensional finite-element program implemented on the ORNL computing system. Results obtained with the program are then presented for our concurrent lines of research, namely, the study of the near-tip region and the analysis of a tensile specimen with a semielliptic crack. The results obtained give a good qualitative picture of the behavior of the specimens. Plans for future work are discussed. (auth)

16290 (CONF-700347-, pp vp, Paper 22) ANALYTICAL INVESTIGATIONS OF THERMAL SHOCK ON NUCLEAR PRESSURE VESSELS. Derby, R. W. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Should a nuclear reactor pressure vessel lose its coolant due to a catastrophic failure of a nozzle or a pipe, an emergency cooling system will be activated to keep the core from overheating. Thus large quantities of relatively cool (130°F) water would be flushed into the reactor in a very short time. The so-called "thermal shock problem" is to determine if the resulting transient thermal stresses will cause a preexisting crack in heavily irradiated material along the equatorial plane of the reactor to grow and hence cause a failure of the complete vessel. A step-by-step approach to the problem has been adopted. First, the transient temperatures for a typical reactor vessel were developed assuming a large, constant value of the film coefficient. Simultaneously the thermal stresses in an unflawed vessel were considered. Particular attention was given to the role of the stainless steel cladding. The cladding acts as an insulator, and hence the peak thermal stresses are about 20 ksi lower in a clad vessel than in an unclad vessel. The next step was to refine the heat transfer analysis to include the effect of film and nucleate boiling. Although there was no obvious way of knowing in advance, the decrease in thermal stresses due to the more sophisticated heat transfer analysis appears to be of negligible importance. The reason is that results of using reasonably conservative values of the film coefficient indicate that the temperature distribution is controlled by the heat flow in metal, not in the film. The next step, currently being implemented, is to superpose a crack on the stress gradient and examine the variations of stress intensity K_I around the crack. The values of K_I will be compared with the best available estimates of K_{Ic}. A comparison of temperature variations through the wall with Charpy "upper-shelf" temperatures for irradiated material is made. (auth)

16291 (CONF-700347-, pp vp, Paper 25) ANLAYSIS OF HSST INTERMEDIATE VESSEL CLOSURE. Hayward, J. A.; Cloud, R. L. (Teledyne Materials Research, Waltham, MA). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

A stress analysis and design evaluation has been performed on the closure portion of the HSST intermediate test vessel in order to ensure design integrity in accordance with Sect. III of the ASME Boiler and Pressure Vessel Code and ORNL Specification JS-120-228 Revision 2. Teledyne Materials Research has developed and employed a technique which permitted the cover, shell, and studs to be coupled as a single orthotropic finite-element model. The design evaluation was performed for a 400°F vessel with 20,000 psi internal pressure. (auth)

16292 (CONF-700347-, pp vp, Paper 27) OBSERVATIONS ON SIZE EFFECTS IN IMPACT ENERGY AND THEIR IMPLICATIONS TO FRACTURE BEHAVIOR. Witt, F. J. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Notable advances have been made recently by the completion of three major research efforts which are indicative of thick section fracture behavior. Specifically, the upper temperature validity limit of plane strain linear elastic fracture toughness for the A 533 steel has been established to be less than 75°F even in specimen thicknesses of 12 in. At 50°F fracture toughness K_{Ic} values of around 140,000 psi $\sqrt{in.}$ (numerically greater than twice the yield stress) have been found. Supporting these findings have been the results from a study of the effect of size on the transition temperature behavior. In thicknesses up to 4 in. an increase of from 70 to 100°F in the NDT-type behavior has been obtained. When correlated with the results from these investigations, an increase of from 130 to 150°F is found for the NDT-type behavior in thicknesses of 12 in. The third investigation now completed has been the testing of dynamic tear specimens. These results have verified the NDT-type behavior for thicknesses of 12 in. to be around 150°F. In addition, the energy-absorbing capacity of the material has been shown to increase by a factor of 3 or more in the narrow temperature range of between 150 and 225°F. Thus the transition behavior typical of smaller standard impact specimens (for example Charpy V-notch impact specimens) exists in all thicknesses over a narrow range of temperature. Of a less encouraging nature is the finding that the material in 12-in. thicknesses exhibits a reduction in energy-absorbing capacity by a factor of around 5 on the upper shelf when compared with standard-size specimens. Another way to express this phenomenon is that in thicknesses of 12 in. the energy-absorbing capacity is about equivalent to that of a Charpy specimen which exhibits around 25 ft-lb when tested. Results from the first large flawed tensile test (cross section of 18 by 6 in.) at upper shelf temperature shows further that the above findings may be indicative of low-energy ductile tearing with significant reductions in the load-carrying capacity of thick sections containing flaws of modest size (less than half the specimen thickness and fully constrained). The results from the second large tensile test are discussed in terms of these implications. These remarks apply to the longitudinal (strong) direction and reflect neither the weaker direction behaviors nor irradiation and other environmental effects which would tend to give still more degrading results. (auth)

16293 (CONF-700347-, pp vp, Paper 28) INDUSTRY COOPERATIVE PROGRAM ON HEAVY SECTION STEELS. Chockie, L. J. (General Electric Co., San Jose, CA). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Industry, with cooperation by all major suppliers and manufacturers, is participating in a program under the auspices of the

Pressure Vessel Research Committee (PVRC) to answer the question "What are the properties and how effective are inspection techniques for heavy section steels and weldments?" The first task, on properties and variation in properties, is being accomplished by testing specimens representing all parts and components in nuclear vessels. Properties are being measured throughout the length and breadth of material from many heats. The second task concentrates on the nondestructive examination of specially prepared samples of welds and plates to develop procedures that can be used to obtain consistent results, as well as describing flaws in terms of size, position, and orientation. Reporting procedures are complete enough that others can duplicate the results. (auth)

16294 (CONF-700347-, pp vp, Paper 29) MECHANISMS OF WELD METAL EMBRITTLEMENT. Rogers, H. C.; Swift, R. A. (Drexel Inst. of Tech., Philadelphia). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Of the three components of a weldment, the parent plate, the heat-affected zone, and the weld metal itself, the latter is the most poorly characterized. Moreover, embrittlement of the weld metal frequently plays a major role in the failure of pressure vessels, particularly as the strength requirements for the plate materials for these vessels continue to rise. The long-range goal of the current investigation, which is sponsored by the Pressure Vessel Research Committee of the Welding Research Council, is the generation of sufficient understanding of the various types of embrittlement that are encountered in weld metals that the frequency of occurrence of such failures may be reduced to a minimum, if not eliminated. The forms of embrittlement that have been encountered are stress-relief embrittlement, temper embrittlement, and creep embrittlement. Information pertinent to weld metal embrittlement is discussed. Initial plans for studying welds in 2¼ Cr–1 Mo steel plate as the first representative base metal composition are described. Attempts are made to minimize uncontrolled variables in the welding process by standardization. Both phenomenological studies and mechanistic studies will be used in an attempt to clearly characterize the various forms of embrittlement and their possible interrelationship in this specific material as well as to determine the causative mechanism(s). (auth)

16295 (CONF-700347-, pp vp, Paper 30) EFFECT OF TENSILE PROPERTIES OF BURST PRESSURE. Copper, W. E.; Spiering, G. A. (Teledyne Materials Research, Waltham, MA). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The Subcommittee on Effective Utilization of Yield Strength of the Pressure Vessel Research Committee is currently investigating the influence of yield strength as related to strain-hardening exponent or to yield-to-tensile-strength ratio upon the bursting pressure of components containing strain-concentrating geometries. Results of a series of constrained disk tests of various geometries and of a wide range of steels are reported. The ratio of the burst pressure to the limit pressure is found to vary in a linear manner, proportional to the strain-hardening exponent and inversely proportional to the elastic stress concentration factor and the thickness. Additional analytical and experimental studies to be performed during the next year are described. (auth)

16296 (LA-4942) HUGONIOT EQUATIONS OF STATE OF Li^6H, Li^6D, Li^7H, AND Li^7D. Marsh, S. P. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1972. 29p. Dep. NTIS $4.50.

Declassified 3 Jan 1974.

An experimental value of 1.08 cm^3/g for $(\partial E/\partial P)_v$ was determined from the Hugoniot data on pressed ^6LiD of various porosities which agrees well with the thermodynamic value of $(\partial E/\partial P)_v$. For each of the isotopic combinations ^6LiH, ^7LiH, ^6LiD, and ^7LiD crystal-density Hugoniots and equations of state were calculated from Hugoniot data on pressed material having porosity of 5% or less and from the thermodynamic values of $(\partial E/\partial P)_v$. No evidence of a polymorphic transition was observed. Ultrasonic measurements of longitudinal and shear-wave velocities in these materials pressed to near crystal density were obtained, and the isotropic elastic moduli were calculated. In addition, elastic constants were determined for crystals of ^7LiH, ^7LiH, and ^7LiD. (auth)

16297 (LBL-1856) MICROSTRUCTURAL VARIABLES AND FRACTURE TOUGHNESS OF HIGH STRENGTH Mo AND Mo–Ni STEELS. Tom, T. (Oak Ridge National Lab., Tenn. (USA)). Sep 1973. Contract W-7405-eng-48. 116p. Dep. NTIS $9.00.

Thesis.

16298 (LBL-2277) PHASE TRANSFORMATION CHARACTERISTICS AND CREEP PROPERTIES OF A LAVES PHASE STRENGTHENED Fe–T–Cr–Mo ALLOY. Bhat, M. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 158p. Dep. NTIS $11.00.

Thesis.

The addition of a small amount of Mo (0.5 at.%) was shown to have a drastic effect on the phase transformation characteristics of alloy Ta7Cr (1 at.% Ta, 7 at.% Cr, balance Fe). The existence of a time–temperature dependent transformation behavior in the alloy Ta7CrMo (1 at.% Ta, 7 at.% Cr, 0.5 at.% Mo, balance Fe) was established. The nature of the aging reaction in alloy Ta7CrMo was investigated using transmission electron microscopy. The phase transformation and aging studies were used in designing heat treatments for obtaining good room and elevated-temperature properties in alloy Ta7CrMo. The creep and stress–rupture properties of alloy Ta7CrMo were determined and were found to be superior to those of alloy Ta7Cr and comparable to some of the best commercially available ferritic alloys at 1100 and 1200°F. A study of the broken surface of creep-rupture specimens with the scanning electron microscope helped in establishing the mechanism of fracture in alloy Ta7CrMo subjected to different heat treatments. (29 figures, 7 tables) (auth)

16299 (N-74-16217) TENSILE PROPERTIES FROM ROOM TEMPERATURE TO 1315 C OF TUNGSTEN-LINED TANTALUM-ALLOY (T-111) TUBING FABRICATED BY HOT ISOSTATIC PRESSING. Buzzard, R. J.; Metroka, R. R. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Feb 1974. 21p. (NASA-TM-X-2964; E-7628). NTIS $2.75.

The effects were studied of a thin tungsten liner on the tensile properties of T-111 tubing considered for fuel cladding in a space power nuclear reactor concept. Results indicate that the metallurgically bonded liner had no appreciable effects on the properties of the T-111 tubing. A hot isostatic pressing method used to apply the liners is described along with a means for overcooming the possible embrittling effects of hydrogen contamination. (auth)

16300 (ORNL-3649-2) EFFECT OF BIAXIALITY IN CREEP-FATIGUE AT ELEVATED TEMPERATURES. Annual Report, January 1–December 31, 1973. Zamrik, S. Y. (Pennsylvania State Univ., University Park (USA). Dept. of Engineering Mechanics). Mar 1974. Subcontract 3649. 35p. Dep. NTIS $4.75.

For Oak Ridge National Lab., TN.

The effect of biaxiality in creep-fatigue interaction at elevated temperature is being investigated. Biaxial fatigue tests were conducted with thin-walled tubular specimens loaded with axial tension-compression and torsion. Biaxial strains were imposed under synchronous loading condition at 25 cycles per minute. Specimens were obtained from extruded 304 stainless steel rods, machined to specifications and annealed in an argon atmosphere at 1092°C. The experimental data covers biaxial fatigue tests at room, 1000°F, and 1200°F, biaxial cumulative fatigue damage tests under a high to low loading sequence at 1000 and 1200°F, and tensile properties tests at 900 to 1200°F. (auth)

16301 (ORNL-4963) MECHANICAL PROPERTIES TEST DATA FOR STRUCTURAL MATERIALS. Quarterly Progress Report for Period Ending April 30, 1974. Hill, M. R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 301p. AT.

The following are reported: mechanical properties of heat-treated Inconel 718; low-cycle fatigue of Type 304 stainless steel (ss); crack propagation of SMA Type 304/308 ss weldments; fatigue crack growth in Type 304 and 316 ss weldments; use of J integral to measure the toughness of Type 316 ss weld metal; creep of a reference heat (9T2796) of Type 304 ss; heat-to-heat variations of Types 304 and 316 ss (creep, tensile, aging, microstructure; strain limit for failure criteria; analysis of specimen geometries for bend, fatigue, and buckle testing; mechanical properties of Type 308 ss weld metal with controlled residual elements (FFTF vessel welds); deformation of whole weldment cross sections; mechanical properties (elastic constants, tensile, creep, crack, fatigue) of 2¼Cr–1Mo steel; mechanical properties of weld-overlaid ss forgings; tensile properties of Type 304 ss for high-temperature design; substructure and mechanical properties of 316 ss, 304 ss, Incoloy 800; and microstructure of tempered low-C 2¼Cr–1Mo steel. (DLC)

16302 (ORNL-tr-2834) INFLUENCE OF GRAIN BOUNDARIES ON DEFORMATION AND FRACTURE OF METALLIC MATERIALS AT HIGH TEMPERATURE. II. Fracture. Ohta, S. Translated by H. Kubota from Zairyo; 23: No. 246, 174-181(1974). 23p. Dep. NTIS $4.25.

The behavior of the grain boundary is shown to be a controlling factor in high-temperature fracture. There are many uncertain aspects in the mechanism of grain boundary fracture. On the other hand, it is believed that there is an intimate relationship between grain boundary fracture and grain boundary slip, and any effort to clarify the mechanism of grain boundary fracture will necessitate a

detailed research into grain boundary slip. On the other hand, when one takes into consideration the strong effect of the atmosphere on grain boundary fracture, there seems to be a need to incorporate chemical studies such as adsorption and corrosion in addition to dynamic and metallographic studies. (auth)

16303 (ORNL-TM-4206) PROPERTIES OF THICK TYPE 308 STAINLESS STEEL WELDS WITH CONTROLLED RESIDUAL ELEMENTS. King, R. T.; Stiegler, J. O.; Goodwin, G. M. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7504-eng-26. 23p. Dep. NTIS $4.00.

The tensile and creep properties of Type 308 stainless steel shielded metal-arc welds with controlled B, P, and Ti contents have been investigated up to 1100°F. The creep ductility of these welds was generally greater than that previously reported for conventional Type 308 weld metal, while strength properties were comparable or greater than those of conventional weld metal. Systematic microstructural and mechanical property variations were found through the thickness of the welds, which may be related to each other by existing theories. Related property and microstructural variations also occurred in the base metal near the weld. Anisotropic deformation occurred in the weld metal. (auth)

16304 (RD/B/N-2784) FATIGUE CRACK PROPAGATION DUE TO RANDOM AMPLITUDE VIBRATIONS: PREDICTION USING CONSTANT AMPLITUDE DATA. Priddle, E. K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1973. 13p. Dep. NTIS (US Sales Only) $4.00.

The fatigue crack propagation characteristics of EN3A mild steel under random loadings have been calculated using program RAFCP. The program required a knowledge of the constant amplitude propagation "law" relating to the material. The stress intensity threshold for propagation Δ Ko at different mean stress intensity values is also required. The computer calculations of endurance of a cracked test piece and the rate of crack propagation are shown to agree with experimental observations. The method may be used for engineering critical assessments of cracked plant or long term reactor design calculations. (auth)

16305 (RDT-F-3-37-T(2-74)) SPECIAL REQUIREMENTS FOR METAL PRODUCTS. (USAEC Division of Reactor Research and Development, Washington, D.C.). Feb 1974. 46p. RSO.

A standard prescribing special requirements for metal products for nuclear and associated applications is presented. This standard supersedes RDT F 3-37T dated July, 1971. (JRD)

16306 (RDT-F-3-37-T(5-74)) SPECIAL REQUIREMENTS FOR METAL PRODUCTS. (USAEC Division of Reactor Research and Development, Washington, D.C.). May 1974. 42p.

A standard prescribing special requirements for metal products for nuclear and associated applications is presented. This standard supersedes RDT F 3-37T dated February 1974. (JRD)

16307 (RDT-F-9-4-T(1-74)) REQUIREMENTS FOR DESIGN OF NUCLEAR SYSTEM COMPONENTS AT ELEVATED TEMPERATURES (SUPPLEMENT TO ASME CODE CASE 1331). (USAEC Division of Reactor Research and Development, Washington, D. C.). Jan 1974. 16p. RSO.

A standard prescribing requirements for design of nuclear systems components at elevated temperatures (supplement to ASME code case 1331) for nuclear and associated applications is presented. (JRD)

16308 (SLA-74-277) FABRICATION OF A CONICAL COMPOSITE STIFFENING RIB. Moss, M.; Cyrus, W. L.; Hoover, W. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 15p. Dep. NTIS $4.00.

A procedure is described for the fabrication of a Borsic fiber-Al-10 w/o Mg matrix conical composite ring designed to stiffen the substructure of the forward portion of a reentry vehicle. The novelty of the technique lies in the liquid phase sintering of the alloy matrix during fabrication that facilitates densification, and the differential thermal expansion of the dies that obviates application of external force. (auth)

16309 (SLL-74-218) QUICKE2: A ONE-DIMENSIONAL CODE FOR CALCULATING BULK AND VACUUM EMITTED PHOTO-COMPTON CURRENTS. Dellin, T. A.; MacCallum, C. J. (Sandia Labs., Livermore, Calif. (USA); Sandia Labs., Albuquerque, N. Mex. (USA)). Apr 1974. Contract AT(29-1)-789. 50p. Dep. NTIS $5.50.

The theory and operational features of the one-dimensional code QUICKE2 are described. The code is used to calculate the bulk and vacuum-emitted photo-Compton current of electrons generated in a material exposed to photons with energies from 1 keV to 10 MeV and arbitrary angle of incidence. The rapid and easy-to-use calculational technique is based on analytical solutions to the transport equation modeling electron multiple scattering and slowing down. (auth)

16310 (SLL-74-5221) MECHANICAL PROPERTIES OF TWO-PHASE URANIUM ALLOYS. Zehr, S. W. (Sandia Labs., Livermore, Calif. (USA)). Apr 1974. Contract AT(29-1)-789. 43p. (CONF-740205-12). Dep. NTIS $5.25.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

It has often been demonstrated in nonuranium alloy systems that deliberate refinement of two-phase pearlitic microstructures can lead to enhanced ductility. The results of recent attempts at applying this concept to various uranium alloys are described. A brief review of reported work of this type on a variety of uranium alloys is included, but the emphasis is placed on the results obtained in U-2 ¼ wt% Nb alloy. The U-Nb phase diagram shows that this material can exist in three different two-phase forms depending on temperature. In addition, the existence of several metastable phases adds a further dimension to the microstructural flexibility. Based on these considerations, various material conditions were examined mainly by tensile testing for mechanical property effects and these results were correlated with microstructural and fractographic observations. Because ductility of unalloyed uranium and many of its lean alloys is known to be sensitive to variations in temperature, humidity and strain rate, ranges of these variables were applied to specimens of the more promising heat treatments. The possibility of further strengthening of such two-phase microstructures by subsequent aging and/or mechanical working is also discussed. The results of this work show that two-phase heat treatments can be useful in some uranium alloys for developing moderate strength (100,000 to 150,000 psi yield) and good ductility (10 to 30 percent elongation). The properties of the alloys processed in this way are also relatively insensitive to extremes of high humidity or low temperature. (auth)

16311 (UCLA-34-P-177-15) REACTOR STEELS STUDIES. Quarterly Progress Report, July-September 1972. Ono, K.; Tetelman, A. S.; Ardell, A. J. (California Univ., Los Angeles (USA). Dept. of Materials). Mar 1973. Contract AT(04-3)-34. 26p. Dep. NTIS $4.50.

A research program directed to the characterization of 2¼ Cr-1 Mo alloy steels containing .01, .04, .08 and .12% C, in order to clarify the role that carbon plays in the development of the microstructure of this particular Cr-Mo steel is described. The microstructure of the normalized and tempered material observed under the light microscope was one of equiaxed grains. However, traveling electron microscopy revealed that in the normalized condition, two phases are present in about equal amounts. These are identified as massive ferrite and bainite. In the normalized and tempered condition, these two phases still predominate in the same amounts, but the bainite has undergone recovery. Neither grain growth nor appreciable carbide precipitation was observed upon tempering. The main product present in the water-quenched material was lath martensite, while in the furnace cooled condition, equiaxed proutectoid ferrite was the only observed phase. These microstructural observations suggest a large shift of the α-region to shorter times in the TTT curve due to lower carbon content. (auth)

16312 (UCLA-34-P-177-16) REACTOR STEELS STUDIES. Quarterly Progress Report, September-December 1972. Ono, K.; Ardell, A. J.; Tetelman, A. S. (California Univ., Los Angeles (USA). Dept. of Materials). Apr 1973. Contract AT(04-3)-34. 20p. Dep. NTIS $4.00.

Research devoted to reactor steel is described. Data and information are included on microstructure of C-2¼ Cr-1 Mo steel in normalized condition and in furnace cooled and water quenched conditions. Information is also included on precipitation in stainless steels including data on stress-rupture of Type 316 at 1400°F. Other work is reported on fracture of Type 304 stainless steel. (JRD)

16313 (UCLA-34-P-177-17) REACTOR STEELS STUDIES. Quarterly Progress Report, January-March 1973. Ono, K.; Ardell, A. J.; Tetelman, A. S. (California Univ., Los Angeles (USA). Dept. of Materials). Aug 1973. Contract AT(04-3)-34. 37p. Dep. NTIS $5.00.

Research on the microstructure of high C 2¼ Cr-1 Mo steel is reported. Specimens in furnace cooled, water-quenched, normalized, and tempered conditions were studied. Results are discussed in terms of crystal structure. Results of studies are also included on precipitation in stainless steels and on effects of microstructure on fracture in 304 and 316 stainless steels. (JRD)

16314 DEVELOPMENT OF ZIRCONIUM AS A REACTOR MATERIAL. Naymark, S. (Nuclear Service Corp., Campbell, CA). Trans. Amer. Nucl. Soc.; 18: 111 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16315 HISTORY OF ZIRCALOY DEVELOPMENT. Thomas, D. E. (Westinghouse Research Labs., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 111-112(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16316 DESIGN CRITERIA FOR DECARBURIZED LMFBR STEAM GENERATOR MATERIAL. Anderson, W. J.; Atkins, D. F. (Atomics International, Canoga Park, CA). Trans. Amer. Nucl. Soc.; 18: 115(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16317 DECARBURIZATION BEHAVIOR OF 2¼ Cr-1 Mo FERRITIC STEEL. Shiels, S. A.; Bagnall, C.; Orbon, S. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 18: 115-116(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16318 EFFECT OF ROLLING ON THE HIGH TEMPERATURE TENSILE AND STRESS-RUPTURE PROPERTIES OF TUNGSTEN FIBER-SUPERALLOY COMPOSITES. Petrasek, D. W. (Lewis Research Center, Cleveland). pp 391-405 of New Industries and Applications for Advanced Materials Technology. Azusa, CA; Society for Advancement of Material and Process Engineering (1974).

From new industries and applications for advanced materials technology symposium; Buena Park, California, USA (23 Apr 1974). See CONF-740437-.

An investigation was conducted to determine the effects of mechanical working on the 1093°C tensile and stress-rupture strength of tungsten alloy/superalloy composites. Hot pressed composites containing either conventional tungsten lamp filament wire or tungsten-1% ThO_2 wire and a nickel base alloy matrix were hot rolled at 1093°C. The hot pressed and rolled composite specimens were then tested in tension and stress-rupture at 1093°C. Rolling decreased the degree of fiber-matrix reaction as a function of time of exposure at 1093°C. The stress-rupture properties of the rolled composites were superior to hot pressed composites containing equivalent diameter fibers. Rolling did not appreciably affect the 1093°C ultimate tensile strength of the composites. (auth)

16319 PROPERTIES OF BERYLLIUM REINFORCED TITANIUM MATRIX COMPOSITES. Goodwin, V. L. pp 440-442 of New Industries and Applications for Advanced Materials Technology. Azusa, CA; Society for Advancement of Material and Process Engineering (1974).

From new industries and applications for advanced materials technology symposium; Buena Park, California, USA (23 Apr 1974). See CONF-740437-.

Beryllium reinforced titanium matrix composites (Be/Ti) are newcomers in the field of composite materials and offer features not found in the longer established composite systems. Be/Ti is similar to alternate systems in offering high specific strengths and moduli; yet differs markedly in being a ductile composite further characterized by limited anisotropy and excellent fracture resistance. Shear properties are outstanding as is the retention of composite properties at temperature to 900°F. Additionally these composites have metal-like fabricability and have an economical price projected at $20 to $30/lb in volume. (auth)

16320 METALLURGICAL ASPECTS OF FAILURE IN METAL-MATRIX COMPOSITES. Ruzauskas, E. J.; Hay, D. R. (Drexel Univ., Philadelphia). pp 1-10 of Failure Modes in Coposites. Toth, I. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

Metal-matrix composites can exhibit a multiplicity of failure modes. These various modes are demonstrated in aluminum-stainless steel and aluminum-tungsten composites by testing under various loading conditions. Another metallurgical aspect of deformation required for analysis of fracture is a characterization of the rate of accumulation of microdamage with increasing strain. A comparison of the rates of accumulation of damage between systems and among loading paths is provided by acoustic emission monitoring during deformation. (auth)

16321 SHOCK COMPRESSION AND RELEASE OF SOLID MECHANICAL MIXTURE. Hopkins, A. K. (Air Force Materials Lab., Wright-Patterson AFB, OH); Spretnak, J. W. pp 327-342 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

The dynamic mechanical loading of a solid material may often result in stress levels such that the impulse process may be described by fluid flow equations. These equations are developed from the Rankine-Hugoniot shock jump conditions and then applied to solid materials through an equation of state. Simple mechanical mixing theory is applied to the description of the shock compression mechanical mixtures. Fiber reinforced composites may be treated as homogeneous mechanical mixtures when the fiber diameter is of the order of the shock rise length. Mixing theory does not adequately describe shock unloading phenomena for metal-plastic mixtures. An analysis based upon the mechanical decoupling of the constituents in a mixture gives good agreement with experimental observations when an adiabatic compression process is assumed. (auth)

16322 NONDESTRUCTIVE MEASUREMENTS OF COLD WORK IN TYPE 316 STAINLESS STEEL. Renken, C. J. (Callaway Technical Associates, Holts Summit, MO); Reimann, K. J.; Berger, H. Mater. Eval.; 32: No. 6, 109-116(Jun 1974).

Nondestructive approaches to the measurement of cold work in Type 316 stainless steel are described, and the initial experimental results are given. The measurement techniques include microhardness, magnetic retentivity, ultrasonic critical-angle reflection, and backscatter Moessbauer methods. The microhardness values related very well to percentage true strain for material with a known history. The magnetic-retentivity method provided useful results on well-characterized samples following the development of a mechanical-modulation technique to minimize background variations. The ultrasonic approach was shown to provide useful measurements on well-characterized material. The Moessbauer measurements proved insensitive to cold work and slight chemistry variations in the samples. However, the latter technique appeared to respond to carbide precipitation in the stainless steel and, therefore, shows promise as a nondestructive test that may be well suited to carbide-precipitation detection. (auth)

16323 DETERMINATION OF THE ENTHALPY OF LIQUID COPPER AND URANIUM WITH A LIQUID ARGON CALORIMETER. Stephens, H. P. (Sandia Labs., Albuquerque, NM). High Temp. Sci.; 6: No. 2, 156-166(Jun 1974).

A liquid-to-gas phase change calorimeter which utilizes liquid argon as the working substance and levitation heating of the samples was devised to measure the enthalpy of liquid copper and uranium to temperatures above 2000°K. One of the advantages of this calorimeter is that it provides an inert environment for reactive samples such as liquid uranium. The heat of fusion of Cu(l) and U(l) were found to be 3303 ± 278 and 2203 ± 142 cal $mole^{-1}$, respectively. The heat capacities for both Cu(l) and U(l) were observed to be constant over the temperature intervals of the measurements [nearly 1000°K for U(l)] and to have values of 8.0 ± 0.7 and 11.6 ± 0.3 cal $mole^{-1}$ K^{-1}, respectively. (4 tables, 4 fig, 27 references) (auth)

16324 MAGNETIC PROPERTIES OF Co_5Sm LODEX AND Co_5Sm LEAD COMPOSITE. Doser, M.; Summitt, R. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9: No. 3, 194-197(Sep 1973).

Demagnetization curves were recorded for composites of Co_5Sm and Lodex, Co_5Sm and Pb, and two different Co_5Sm powders of widely different H_{ci} values. 'Kinks' observed for the first and third composites but not the second show that the effect results from the difference in H_{ci}. The Co_5Sm Lodex composites produced 'kinks' in only the 20 to 80 wt % Lodex range. Significant improvement of energy product in Lodex composites requires more than 70 wt % of Co_5Sm. Better results can be obtained by diluting Co_5Sm with Pb. For applications operating at high load lines and requiring high inductions, improved properties may be obtained by small additions of Co_5Sm to Lodex. The energy product and H_{ci} can be improved for Co_5Sm/Pb composites by Zn coating the magnetic particles prior to pressing. One sample produced BH_{max} values of 7.5 MgOe and H_{ci} of 13.5 kOe. 10 ref. (Metals Abstr.)

16325 OBSERVATION OF DOMAIN STRUCTURES IN $SmCo_5$ BY ELECTRON MICROSCOPY. Riley, A.; Jones, G. A. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9; No. 3, 201-203(Sep 1973).

In situ observations of the domain structure of $SmCo_5$ under changing magnetic field conditions have been carried out with a high-voltage electron microscope. These observations demonstrate the existence of some pinning processes and suggest that while pinning at crystallographic defects may have some significance, that at grain boundaries may be more important. Such a view is supported by the apprent disregard of domain walls for the majority of crystallographic defects which penetrate the homogenized material and the pinning observed at a grain boundary. (Metals Abstr.)

16326 INTERNAL FRICTION IN RHENIUM. Callens-Raadschelders, M. Antwerp, Belgium; Rijksuniversitair Centrum te Antwerpen (1974). 129p.

Thesis.

Internal friction spectra of polycrystalline hcp Re show a relaxation peak, which is attributed to double-kink generation. Further evidence for this relaxational model follows from the interpretation of other experiments. The introduction of a relaxation peak and the decrease of the background damping, occurring as a result of ageing at room temperature, are interpreted in terms of dislocations moving, during ageing from a position nonparallel with a Peierls valley, into a position in a Peierls valley and hence changing their behavior from string-like to double-kink generation conditioned. The behavior of the amplitude dependence too can be understood by taking account of the influence of double-kink generation. Whereas in the Granato–Luke theory the amplitude dependence is interpreted in terms of a dislocation–point defect interaction model, it is suggested that the amplitude dependence is additionally influenced by an intrinsic dislocation property, namely the double-kink generation. From these amplitude-dependent measurements, the importance of the presence of internal stresses on the internal friction behavior of Re, is shown. Moreover, the interpretation is given for the differences which occur between the results on polycrystalline material and reported results on single crystals, in terms of a different response to plastic deformation. Theoretical calculations are also performed, concerning the atomistic aspects of the perfect and the dislocated lattice. (auth)

16327 SYSTEM RHENIUM–COBALT–BORON. Chepiga, M. V.; Kuz'ma, Yu. B. (Lvov State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1505-1511(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1688-1696(Oct 1973).

Using x-ray structural and x-ray phase analysis, the system Re–Co–B was investigated and isothermal cross sections at 1300, 1000, and 800°C were constructed. The existence and the crystal structure of new ternary compounds: $(Re, Co)_3B$ (Ti_3P structure), ReCoB (TiNiSi structure) and $(Re, Co)_7B_4$ (new type of structure) were extablished. (auth)

16328 EFFECT OF MICRO-ADDITIONS OF NICKEL ON THE MECHANICAL PROPERTIES OF MOLYBDENUM AND ITS ALLOY WITH CARBON. Malashenko, I. S.; Statkevich, V. N.; Shcukin, A. A. Probl. Prochnosti; No. 9, 51-55(Sep 1973). (In Russian).

The effect of traces of Ni on the mechanical properties of Mo and Mo–C alloys of various compositions was studied in relation to test temperature. On adding 0.01 to 0.06 wt.-% of Ni to pure Mo the resultant alloys were very inclined to suffer dynamic aging in the range 700 to 800°C. This effect was caused by changes taking place in the structure of the solid solution. The effect was even more noticeable in the case of Mo–C alloys, for which the concentration of the C in solid solution increased with Ni content. On annealing the alloys at above 1400°C the solid solution of C in Mo decomposed in the presence of 0.05 wt-%Ni. (Metals Abstr.)

16329 EFFECT OF STRESS CONCENTRATIONS ON THE MECHANICAL PROPERTIES OF MOLYBDENUM SAMPLES WITH A PROTECTIVE COATING DURING TESTS IN AN OXIDIZING MEDIUM. Zelenyuk, E. E.; Shkolyar, V. S.; Sosnovskii, L. A.; Spik, A. P. Probl. Prochnosti; No. 9, 56-59(Sep 1973). (In Russian).

The results of mechanical tests carried out on plane Mo samples with or without stress raisers (in the form of cuts and notches) are analyzed. These samples were subjected to ordinary tensile tests and also to creep tests in an oxidizing medium (either O or ordidary atmospheric air) up to 1500°C. The results were compared with existing data relating to tests carried out in vacuum. The short-term strength of the smooth samples at 800 to 1500°C was lower than that of the notched samples. The UTS of both smooth and notched samples in air was lower than the value obtained in vacuum. The creep strength of samples with protective coatings in air was the same as in vacuum. (Metals Abstr.)

16330 EFFECT OF CARBIDE PRECIPITATION ON FATIGUE CRACK PROPAGATION IN TYPE 316 STAINLESS STEEL. Mahoney, M. W.; Paton, N. E. (Rockwell International, Thousands Oaks, CA). Nucl. Technol.; 23: No. 1, 53-62(Jul 1974).

The effects of carbide precipitation and carbon content on crack propagation rates in Type 316 stainless steel were determined at −196 to 649°C. It was shown that neither carbon content nor carbide precipitation had any recordable effect on crack propagation rates for the range of parameters investigated. Fatigue life, however, has been shown by other investigators to be a function of both carbon content and carbide distribution. These results provide evidence for a hypothesis that crack initiation is sensitive to carbon content and morphology in Type 316 stainless steel, whereas crack propagation rate is not. A good correlation was obtained between macroscopic crack growth rate and striation spacing measurements. (7 fig) (auth)

16331 PROCESSING THE MARAGING STEELS. Hall, R. C. (Martin Marietta Corp., Orlando, FL). Metal Progr.; 105: No. 6, 41-42(Jun 1974).

Control of fracture toughness in maraging steels (nominal composition 18 Ni, 8.5 Co, 5 Mo, 0.5 to 1.0 Ti, and 0.1 Al) is discussed. Toughness considerations are examined in which it is noted that increases in yield strength are generally associated with decreases in fracture toughness. It is also noted that impurities lower toughness, vacuum melting improves toughness, welding degrades toughness, and underaging appears harmful to toughness. (JRD)

16332 EFFECTIVE PAIR POTENTIALS FOR LIQUID Na AND LIQUID K. Allawadi, N. K. (Freie Univ., Berlin); Banerjee, P. K.; Choudry, A. J. Chem. Phys.; 60: No. 7, 2571-2573(1 Apr 1974).

Recent x-ray structure data was used to generate effective pair potentials for liquid sodium and liquid potassium. This is done on the basis of three current theories (Percus-Yevick, hypernetted chain, and Born-Green) which relate the effective pair potential to the radial distribution function. Qualitatively, all the three pair potentials have similar features. Contrary to the recent suggestion of Howells and Enderby, the Born-Green theory seems to be equally applicable to liquid metals. (auth)

16333 THERMIONIC EMISSION PARAMETERS OF TANTALUM(110) AND TANTALUM(211). Nicholson, D. J. New York; Syracuse Univ. (1973). 161p. University Microfilms Order No. 74-8361.

Thesis (Ph.D.)

Two single-crystal Ta ribbons were incorporated as the interchangeable emitter and collector in a Shelton geometry tube housed in a baked stainless steel chamber incorporating both ion and Ti sublimation pumps, and routinely pumped to 3×10^{-11} torr. The crystals were flashed at 2700°K by resistive heating prior to all measurements. The measured thermionic emission constants for the two crystals are: Ta(110): $\phi^* = 4.68 \pm 0.03$ eV; $d\phi/dT = 73 \pm 3$ V/K; $\phi = 4.67 \pm 0.04$ eV at 300°K; and $\alpha_R = 160 \pm 28$ A/cm^{2}K^2. Ta(211): $\phi^* = 4.42 \pm 0.04$ eV; $d\phi/dT = -157 \pm 8$ V/K; $\phi = 4.26 \pm 0.03$ eV at 300°K; and $\alpha_R = 25 \pm 6$ A/cm^{2}K^2. The electron reflection coefficients for the two crystals were measured in the range of incident electron energy of 0–80 eV, observed to be a reproducible feature of the surfaces flashed to the above temperature, and the similarities with such coefficients measured for the same faces of tungsten noted. (Diss. Abstr. Int., B)

16334 MAGNETIC STRUCTURE AND CRYSTAL-FIELD LEVELS IN PrAg. Brun, T. O.; Lander, G. H.; Price, D. L.; Felcher, G. P.; Reddy, J. F. (Argonne National Lab., IL). Phys. Rev., B; 9: No. 1, 248-253(1 Jan 1974).

Neutron scattering experiments have been performed on polycrystalline samples of PrAg (CsCl structure) to determine the magnetic structure at low temperature and the energy separation of the crystal-field levels. At 14°K PrAg becomes antiferromagnetic with the ($\pi\pi$0) structure. This consists of ferromagnetic (110) planes coupled antiferromagnetically. Ordered moments of $(2.1 \pm 0.1)\mu_B$/(Pr atom) lie in the (001) planes. The crystal-field energy levels in PrAg have been measured directly with neutron spectroscopy at 5, 78, and 297°K. Results of the measurements indicate that the Γ_3 level is the ground state. The over-all splitting is ~20 MeV and the crystal-field parameters W and x are −0.37 ± 0.02 MeV and −1.00 ± 0.01, respectively. A calculation based on a first- and second-neighbor point-charge model with neutral Ag ions and tripositive Pr ions gives reasonable agreement with the experimental parameters. The linewidths of the crystal-field transitions are observed to be very broad (full widths at half-maximum are ~11 MeV at 297°K). A simple Ruderman-Kittel-Kasuya-Yosida (RKKY) model has been used to explain these widths, which are at least a factor of 2 larger than observed, for example, in the praseodymium monopnictides. (auth)

16335 EXPERIMENTAL EVIDENCE FOR THE FORMATION OF A SINGLET GROUND STATE AT LOW TEMPERATURES IN THE DENSE KONDO SYSTEM $CeAl_3$. Mahoney, J. V. (Univ. of Pittsburgh); Rao, V. U. S.; Wallace, W. E.; Craig, R. S.; Nereson, N. G. Phys. Rev., B; 9: No. 1, 154-157(1 Jan 1974).

Heat-capacity measurements have been performed on $CeAl_3$ and $LaAl_3$ between 1.8 and 300°K. The difference in the heat capacities of these two compounds (ΔC_p) has been regarded as the additional contribution due to the local moments on Ce^{3+} ($J = 5/2$) in $CeAl_3$. The ΔC_p-vs-T curve displays two pronounced anomalies peaking near 5 and 25°K. The total entropy under this curve is nearly R ln6 which is in excess of the maximum possible crystal-field entropy by R ln2. Of the two anomalies, the one at 25°K has been interpreted as being caused by crystal-field effects alone since it accounts for nearly R ln3 of the measured entropy.

Neutron-diffraction measurements, performed at 3.5, 4.6, and 300°K, show that the lower-temperature heat-capacity anomaly is not caused by magnetic ordering in $CeAl_3$. The results have therefore been interpreted on the basis of the combined effects of crystal-field splitting and the Kondo effect on the Ce^{3+} ions. Analysis of the measured entropy leads to the conclusion that the low-temperature ground state in this Kondo system is a spin- and orbit-compensated singlet, in accord with recent theoretical predictions. (auth)

16336 STUDY OF HYDROGEN EMBRITTLEMENT OF VARIOUS ALLOYS. Groeneveld, T. P.; Fletcher, E. E.; Elsea, A. R. Washington, DC; National Aeronautics and Space Administration (1967). 135p.

The susceptibilities of 14 selected high-strength alloys to H-stress cracking were evaluated. Ti-6Al-4V, alloy 718, Waspaloy, René 41, and U-212 steel were insensitive to H-stress cracking; the remaining nine alloys in order of increasing susceptibility were 17-7 PH stainless steel, AISI Type 410 stainless steel, AM-355 stainless steel, 18 Ni(250) maraging steel, AISI E-8740 steel, AISI Type H-11 tool steel, 17-4 PH stainless steel, AISI 4130 steel, and AISI 4340 steel. The susceptible alloys were used to evaluate the H-embrittling tendencies of selected cleaning, inhibited acid pickling and electroplating processes, and to evaluate the effectiveness of selected baking treatments for relieving H embrittlement. All of the conventional electroplating processes evaluated embrittled one or more of the steels. The hard-Cr electroplating process was the most embrittling. Two of the reportedly low-embrittling Cd electroplating processes, the nonaqueous DMF-Cd and the nonaqueous cadmium acetate-methanol electroplating processes, did not cause embrittlement under the experimental conditions employed. With one exception, none of the commercially used preplating cleaning processes introduced enough H to cause H-stress cracking. The exception was the cleaning process used prior to bright-Cd electroplating. None of the ultrahigh-strength steels was embrittled as a result of exposure to anodic-alkaline cleaning, anodic-acid cleaning or soak-alkaline cleaning. Eight varieties of H embrittlement inhibitors are discussed. (Metals Abstr.)

16337 USE OF FERRITIC-AUSTENITIC STEELS IN NUCLEAR POWER ENGINEERING. Gerasimov, V. V.; Gromova, A. I.; Belous, V. N.; Gosteva, V. A.; Fel'dgandler, E. G. At. Energ. (USSR); 36: No. 4, 273-276(Apr 1974). (In Russian).

Corrosion behavior of ferritic-austenitic steels during nuclear reactor operation is considered. The feasibility of using these steels in reactor engineering instead of X18H10T steel is shown. (1 figure, 7 tables) (auth)

16338 SHOCK COMPRESSIBILITY OF POROUS TUNGSTEN, MOLYBDENUM, COPPER, AND ALUMINUM IN THE LOW PRESSURE REGION. Bakanova, A. A.; Dudoladov, I. P.; Sutulov, Yu. N. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 117-122(1974). (In Russian).

Experimental results on the behavior of porous Mo, W, Cu, and Al with original density corresponding to ≈ 30 and 50% of the density of the bulk material during impact by shock waves with intensity from 10 to 800 kbar are reported. The pattern of the shock compression curve in the $p-\rho$ plane indicates that at some pressures p^*, the compression of the porous material proceeds to the state of the bulk material. For an original density of ≈ 50%, the value p^* is 65, 40, and 35 kbar for W, Mo, and Cu respectively. At lower densities (≈ 30% of the density of the bulk material), the value of p^* is decreased about 2 times in comparison with the values given for ≈ 50%. In Al in the pressure interval from 6.5 to 200 kbar, the compression of the porous material to the state of the bulk material did not occur. (tr-auth)

16339 PRECIPITATION AND RECRYSTALLIZATION IN DISPERSION HARDENED STEELS. Lamberigts, M.; Greday, T. (Centre de Recherches Metallurgiques, Liege). Met. Rep. CRM (Cent. Rech. Met., Brussels); No. 38, 23-38(1974).

The mechanical properties of structural steels depend heavily on the state of precipitation induced by their thermomechanical history. The role of reheating conditions and the thermodynamic parameters which govern the dissolution of aluminum, vanadium, and niobium are studied. Extrapolation of the results to other steels is made. Determination of the critical cooling leading to the peak hardening, static recrystallization of deformed austenite, the retarding effect of niobium, and role of vanadium are also discussed. (auth)

16340 MATERIALS DATA HANDBOOK: INCONEL ALLOY 718. Huntsville, AL; Marshall Space Flight Center (1967). 144p.

The handbook presents a comprehensive summary of the property information presently available on this alloy. The scope of the information includes physical and mechanical properties at cryogenic, ambient, and elevated temperatures and is supplemented with useful information in such areas as material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication and joining techniques. Design data are presented, where available, and these data are complemented with information on the typical behavior of the alloy. (111 references) (Metals Abstr.)

16341 OBTENTION OF IMPROVED TENSILE PROPERTIES AND HOT-CORROSION RESISTANCE IN COBALT-BASE SUPERALLOYS. Drapier, J. M.; Davin, A.; Coutsouradis, D.; Habraken, L. (Centre de Recherches Metallurgiques, Liege). Met. Rep. CRM (Cent. Rech. Met., Brussels); No. 38, 39-57(1974).

Present-day superalloys are used for high-temperature applications, more specifically in the field of gas-turbine components. Their compositions, which have become progressively more complex in order to meet increasingly stringent operating conditions, are such that different strengthening mechanisms are operative. The development of satisfactory materials has only been possible as a result of new processing techniques. The aim of the paper is to give some insight into recent developments of cobalt-base superalloys, with particular emphasis on work carried out at CRM. It is divided into two parts: the first deals with the relationship between microstructure and mechanical properties as dependent on composition and method of processing; and the second is concerned with their high-temperature corrosion resistance. (auth)

16342 LOW-TEMPERATURE EMBRITTLEMENT OF Ti-6Al-4V AND INCONEL-718 BY HIGH-PRESSURE HYDROGEN. Walter, R. J.; Chandler, W. T. Washington, DC; National Aeronautics and Space Administration (1970). 77p.

Tensile properties are reported of notched or unnotched specimens of Ti alloy Ti-6Al-4V (STA) at 70, -109, and -320°F under air at 1 atm or H or He at 1000 and 2000 psi. Under 200-psi H, the notch strength was reduced by ~45% at 70°F, 8% at -109°F, and nil at -320°F; unnotched specimens essentially were not embrittled at these temperatures. Information is also available on tensile properties of notched or unnotched specimens of Inconel-718 at temperatures of 140, 70, -109, and -320°F under air at 1 atm or H or He at 1000 and 2000 psi. Under H at 2000 psi the notch strength was reduced by ~15% at 70 and 140°F and almost nil at -109 and -320°F; unnotched specimens were not embrittled. This degree of embrittlement is much lower than earlier observations under 1000-psi H. The 1000-cycle fatigue strength of precracked specimens of Inconel-718 was 22% less under H at 2000 psi than under the same concentration of He. (Metals Abstr.)

16343 MAGNETIC STRUCTURES OF Er SINGLE CRYSTAL IN 0-20 kOe FIELD. Atoji, M. (Argonne National Lab., IL). Solid State Commun.; 14: No. 10, 1047-1050(15 May 1974).

A neutron diffraction study of erbium metal in magnetic fields H = 0 to 20 kOe has revealed the first and third harmonic moments $\perp c_0$ and the third harmonic moment $\parallel c_0$ in the highest temperature phase; in the intermediate phase, the higher odd-harmonics of up to 21st, appreciable changes on the moments and the wave numbers as H $\parallel c_0$ exceeding critical fields, and characterization of three sub-phases; field effects $\parallel a_0$ or b_0, influencing only the lowest temperature phase. (auth)

16344 INVESTIGATION OF SOME HEAT RESISTANCE CHARACTERISTICS OF NIOBIUM ALLOYS 5VMTs, 5VMTsU, AND 5VMTTs AT 1100°C. Tsviliuk, I. S.; Pyl'nikov, V. I.; Men'shikh, V. A. (Inst. of Problems in Materials Science, Kiev). Probl. Prochnosti; 5: 39-42(Nov 1973).

16345 ELECTRICAL CONDUCTIVITY OF INTERMETALLIC COMPOUNDS OF THE Nd-Tl SYSTEM. Cismaru, G. D.; Spacu, P. (Univ. of Bucharest). An. Univ. Bucuresti, Chim.; 22: No. 1, 53-59(1973).

The intermetallic compounds Nd_2Tl_3, NdTl, and $NdTl_3$ of the Nd-Tl system were prepared, and their electrical conductivity at the room temperature studied. An exponential increase of conductivity was observed on increasing the atomic fraction of thallium. From the investigation carried out on this system, it results that no Nd_2Tl compound appears. Values of $N\bar{e}^2 \times l$ product for each compound of Drude's corrected equation were determined and their electron mean free path calculated. (auth)

16346 SINGLE CRYSTAL GROWTH AND THE ELASTIC BEHAVIOR OF In_2Bi. Chung, D. Y.; Saunders, G. A.; Savage, C. (Durham Univ. (UK)). Phys. Lett., 47: No. 6, 449-450(6 May 1974).

Ultrasound velocities have been measured in In_2Bi crystals grown by zone-levelling. The elastic constants are reported. The elastic behavior is remarkably isotropic: a pure shear and two almost pure waves propagate in all directions other than pure mode directions. (auth)

16347 ELECTRON IMPACT DESORPTION OF HYDROGEN ON TUNGSTEN. II. Hydrogen in Mixed Adsorption Layers.

Jelend, W.; Menzel, D. (Technische Univ. Muenchen (F. R. Germany). Inst. fuer Physikalische Chemie und Elektrochemie). Surf. Sci.; 42: No. 2, 485-507(Apr 1974).

The electron impact desorption (EID) of H^+ ions and of H_2 molecules from hydrogen coadsorbed with carbon monoxide or oxygen on tungsten has been investigated mass spectrometrically. It is shown that the high EID cross sections for hydrogen on tungsten reported in some earlier investigations must have been due to coadsorbed states. These states have been investigated in some detail with respect to their general adsorptive (relative coverages, sticking coefficients, isosteric heats, and desorption rates) and their EID properties (total and ionic cross sections, threshold energies). The results stress the high specificity of EID for certain (usually weakly bound) adsorption states and its applicability for the investigation of such states even in the presence of other states with much higher populations. (auth)

16348 ADSORPTION AND SOLUTION OF H_2 AND N_2 BY Ta AND Nb. Ko, S. M.; Schmidt, L. D. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering). Surf. Sci.; 42: No. 2, 508-524(Apr 1974).

The condensation and desorption kinetics of H_2 and N_2 on polycrystalline wires of Ta and Nb are examined for solute concentration between 0.1 and 100 monolayers. Accurate comparisons of adsorbate densities and sticking coefficients on Ta, Nb, Mo and W are obtained by making simultaneous measurements on all four substrates in the same vacuum system. Desorption exhibits second order kinetics for all substrates at all coverages. Desorption activation energies are higher on Ta and Nb than on W and Mo for both gases. Diffusion limited desorption is observed for H_2 at high heating rates. Solution of H_2 occurs at measurable rates ($s \gtrsim 0.01$) in Ta and Nb even at 78°K while for N_2 no solution is observed for T < 600°K. (auth)

16349 THE ADSORPTION OF XENON BY W(111), AND ITS INTERACTION WITH PREADSORBED OXYGEN. Dresser, M. J.; Madey, T. E.; Yates, J. T. Jr. (National Bureau of Standards, Washington, D. C. (USA)). Surf. Sci.; 42: No. 2, 533-551(Apr 1974).

The physisorption of Xe on W(111) and of Xe on partial layers of oxygen chemisorbed on W(111) has been studied using flash desorption and work function methods. It has been found that xenon adsorbs up to monolayer coverages at 104K. Xenon desorbs from W(111) as a single binding state following first order kinetics. At low coverages ($\theta_{xe} < 0.07$) the binding energy decreases with increasing coverage possibly because of the presence of high energy adsorption sites due to crystal imperfections and edge effects. For $\theta_{xe} > 0.07$ the desorption data fit a first order rate expression with a desorption energy of 9.3 kcal/mol and preexponential $\nu = 10^{15}$ s^{-1}. The observed work function change of -1.1 ± 0.1 eV is consistent with monolayer estimates reported in field emission studies of physisorbed xenon on tungsten. The effect of preadsorbed oxygen layers on the physisorption of xenon on this surface is very striking. The energy of desorption shifts as much as 50% higher for a moderate exposure of oxygen. Several physisorption models are explored along with estimates of dispersion and electrostatic interaction contributions. (auth)

16350 CREEP STRAIN IN AUSTENITIC STAINLESS STEEL UNDER COMPLEX STRESS CONDITIONS: CREEP UNDER PROGRESSIVE LOADING AT HIGH TEMPERATURE: CREEP UNDER THERMAL GRADIENT. Petrequinn, P. (CEN, Saclay, France); Calvet, J. N.; Lebret, P.; Duret, G. pp 145-167 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

During their in-core residence, fuel element cans are subjected to stresses of different kinds, especially fission gas pressure, which increases as a function of time, and to thermal stresses due to the temperature gradient across the wall of the can. Tests were carried out approximating actual stress conditions as closely as possible and the results analyzed in the light of results of tests made at constant stress and temperature. Analysis of these results provides a method of determining strain under progressive loading. The results obtained at 700°C with 316 steel are compared with curves plotted on the basis of the constant stress tests by integration, in accordance with the time-hardening and strain-hardening theories, of the relationship $\epsilon = f(\sigma,t)$ representative of primary creep. Creep tests were made at 750°C under temperature gradient. The results are in agreement with the predictions based on tests at uniform temperature. (auth)

16351 EFFECT OF TEMPERATURE AND Al AND Mo ADDITIONS ON THE MECHANICAL PROPERTIES OF THE Fe-13% Cr ALLOY AND STEEL. Carvalhinhos, H.; Proenca, J.; Sequeira Martins, L. F. (Laboratorio de Fisca e Engenharin Nucleares, Portugal). pp 199-214 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

Ferritic stainless steels have repeatedly been suggested as potential cladding and structural materials for high-temperature and fast nuclear reactors and hence a study was initiated on the mechanical properties of this type of steel. Results are presented of constant strain rate tensile tests ($\approx 2 \times 10^{-3}$ min^{-1}) from room temperature to 715°C on vacuum remelted nominal 13%Cr-0.04 to 0.8%C ferritic steels containing 0, 0.13%, 2.19%, and 4.15% Al or 0.23%, 0.56%, 0.64%, and 1.11% Mo. Data are also given on similar tests performed in the same temperature range for nominal 13% Cr-Fe alloys containing 0, 1.05%, 1.92%, and 4.43% Al melted from the pure metals. At 265°C all the tests already done show that deformation proceeds by serrations (Portevin-Le Chatelier effect) regardless of whether the material is a steel or an alloy. At 415 and 465°C flow stress drops were only observed for the Al-containing steels. The tests performed at 565 and 715°C showed work-softening and no serrations. The Portevin-Le Chatelier effect was attributed to interactions of the interstitial and substitutional solute atoms with dislocations in the bcc structure. Stress relaxation tests were also run at room temperature to obtain the apparent activation volumes. For steels, the values obtained are scattered between about 100 and 130 b^3 (b = Burgers vector), being weakly dependent on stress, strain, composition, and alloying species. Although Al appreciably strengthens the 13% Cr steel, the behavior summarized suggests that the mechanism controlling deformation at room temperature is the same for all the tested steels. The interstitial content may determine the value of the apparent activation volume. Strengthening by Al was found to be strongly temperature dependent. Stress relaxation tests at 20, 75, and 140°C yielded values of the activation volume and the internal shear stress τ_i. Analysis of the data disclosed that Al content and temperature seem to affect τ_i directly. (auth)

16352 PROPERTIES OF FERRITIC STEELS STRENGTHENED FOR USE AS FUEL CLADDING IN FAST REACTORS. Huet, I. J.; Casteels, F.; De Wilde, L.; Leroy, V.; Snykers, M.; Van Asbroeck, Ph. (Centre d'Etude de l'Energie Nucleaires, Mol, Belgium). pp 215-225 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

For some years dispersion-reinforced ferritic steels have been under study with a view to their possible use as a fuel cladding material for sodium-cooled fast reactors. A number of important properties have been investigated and so far no unfavorable characteristic has been demonstrated. The basic alloy chosen nominally contains Fe, 13%Cr, 1.5%Mo, 3.5%Ti, to which either 2%TiO_2 or 1%Y_2O_3 are added by a powder metallurgy process. The mechanical properties in the hot state have been examined by fracture tests at 700°C as a function of time (up to 4000 hours); at this temperature the alloys studied compare very favorably with the best austenitic steels. Variations in composition showed some sensitivity to titanium content and silicon content but thanks to the method of preparation there is no difficulty in remaining within the prescribed limits. Cold mechanical working can greatly reduce the strength of the alloys at 700°C but heat treatment can restore their properties completely. Dynamic sodium corrosion tests at 700°C showed that after 4000 hours the affected zones were insignificant and had no important effect on mechanical strength at high temperatures. Neutron irradiations of these alloys in the cold state and at 700°C up to 1.6×10^{22} n/cm^2 and 3×10^{21} n/cm^2 respectively (>0.1 MeV) demonstrated their remarkable resistance to embrittlement in the mechanical tests at 700°C. Compared with other alloys, they showed the maximum elongation-to-rupture after irradiation. Tests consisting of simulated bombardment by high-energy (1 MeV) electrons resulted in virtually zero swelling ($\Delta V/V < 0.5\%$) over a large temperature range. In view of all these properties of dispersion-reinforced ferritic alloys, there is a genuine possibility of their being used as a cladding material for fast reactor fuel elements. (auth)

16353 FRICTION BEHAVIORS OF INCONEL 718 AND STELLITE 6 AS FUEL ASSEMBLY DUCT PAD MATERIAL. Dietz, W. (INTERATOM, Bensberg, Ger.); Wild, E. pp 309-321 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

In SNR-300 about 500 hexagonal assemblies are clamped together by a core restraint system to a closed packed array. During fuel element lifetime, operational situations exist in which the friction coefficients between contacting assembly spacer pads are of special interest for the reactor designer: (a) Friction coefficients influence loads during removal or reinsertion of assemblies; and (b) Excessive friction during core loading or reactor start-up prevents the required close compacting of hexagonal assemblies. These problems have to be solved by selection of adequate materials with low friction coefficients. Inconel 718 and Stellite 6 were selected as potential duct pad materials. The friction behavior of these two materials in sodium has therefore been investigated under various experimental conditions of temperature, geometry of sliding contact, sliding distance, and contact pressure representative of duct behavior. Similar experiments were conducted in four different types of test facilities. The results are that a larger variation of friction coefficients was observed for Inconel 718 than for Stellite 6H. This was related to a boundary lubrication condition for Inconel 718. The scattering of friction coefficients above critical values of 0.57 (self-looking condition) may limit the applicability of Inconel 718 as spacer pad material for some design conditions. (auth)

16354 NUCLEAR ACOUSTIC RESONANCE OF V^{51} IN A SINGLE CRYSTAL OF V_3Si ABOVE AND BELOW THE MARTENSITIC TRANSFORMATION. Buttet, J. (Section de Physique, Université de Genève, Genève, Switzerland); Läuger, K. Phys. Rev. B 9: No. 11, 4643-4653 (1 June 1974).

The nuclear acoustic resonance of V^{51} in a single crystal of the intermetallic compound V_3Si has been observed. This crystal becomes superconducting at 16.3 °K and shows a martensitic transformation at T_m=21.3 °K. The electric-field-gradient tensors and the isotropic and anisotropic parts of the Knight shift have been determined at the different V^{51} sites above and below T_m. Where they can be compared, our values are in good agreement with those obtained in V_3Si powders. Both the electric-quadrupole interaction and the Knight shift are essentially determined by the d conduction electrons. As an example, we discuss the anisotropy of the Knight shift at 77 °K with respect to two linear tight-binding theories of Labbé and Friedel and Goldberg and Weger. The latter theory gives qualitative agreement for a convenient choice of the band-structure parameters and the Fermi energy E_F. Accordingly, E_F lies at the upper side of the δ_2 band. The measured quantities vary strongly with the phase transformation (where two different V^{51} sites develop). The changes of the electric field gradient are found to be one order of magnitude larger than their point-charge values. The same is true for the magnitude of the (field gradient) asymmetry parameter η=0.12, obtained for the V^{51} site with mm2 point symmetry. It is shown that the tetragonal c axes lie predominantly in a plane which is nearly perpendicular to the crystal growth axis. (auth)

16355 MAGNETIC SUSCEPTIBILITY OF La:Ce. De Gennaro, S.; Borchi, E. (Istituto di Fisica dell'Università, Firenze 50125, Italy). Phys. Rev. B 9: No. 11, 4985-4987 (1 June 1974).

A previous calculation of the crystal-field effects on the magnetic susceptibility of La:Ce alloys is extended in order to take into account all the contributing terms besides the logarithmically divergent ones. Numerical calculations show that previous neglected terms are of considerable importance in the low-temperature range and cannot be ignored if a reliable result is required. (auth)

16356 PERPENDICULAR ANISOTROPY IN $Gd_{1-x}Co_x$ AMORPHOUS FILMS PREPARED BY rf SPUTTERING. Cronemeyer, D. C. (IBM Research Center, Yorktown Heights, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 85-89(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

In a study of $Gd_{1-x}Co_x$ amorphous alloy films ($0.5 < x < 0.95$) prepared by rf sputtering onto glass substrates, the perpendicular anisotropy energy K_u as a function of composition and rf bias is derived from measurements of ferromagnetic resonance in the parallel and perpendicular configurations. This evaluation is facilitated by having magnetic moment data obtained with a force balance. With increasing rf bias, there is a monotonic increase of the Co concentration, whereas K_u at first rises and then appears to pass over a maximum. Starting from a $GdCo_2$ target, K_u has a maximum of 4×10^5 ergs/cm^3 for $x = 0.72$, dips to a low value near the compensation composition ($x = 0.795$), and increases again beyond this point. FMR values of K_u are roughly confirmed by analyzing the magnetization curves obtained with the magnetic field parallel to the plane of the samples. The approximate compositional range of interest for bubble domain applications ($K_u \geq 2\pi M_s^2$) seems to be $0.71 < x < 0.86$. The mechanisms of anisotropy in amorphous $Gd_{1-x}Co_x$ are discussed with reference to various possible models. (auth)

16357 ERROR RATE MEASUREMENTS IN BUBBLE CIRCUITS ON PERMALLOY COATED YEu GARNET FILMS. Doyle, W. D.; Flannery, W. E.; Coleman, J. A. (Sperry Univac, Blue Bell, PA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 152-156(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

A quantitative method for describing the performance of a bubble circuit is presented. It is shown that two parameters are required to separately specify the margin and error rate. Data on the upper margin are presented as a function of in-plane rotating field, field shape, pulse sequence, film defects, the presence of hard bubbles, and frequency for a typical integrated bubble circuit on a permalloy coated YEu garnet film. (auth)

16358 NMR STUDY OF THE ELECTRON SPIN DENSITY NEAR IRON GROUP ATOMS IN Cu. Boyce, J. P.; Aton, T. J.; Slichter, C. P. (Univ. of Illinois, Urbana). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 252-256(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

The nuclear resonances of Cu atoms which are near neighbors to 6 of the 3d transition element impurities in dilute Cu alloys were observed. These systems are of interest in the Kondo problem. The resonances appear as satellites split from the strong resonance of the distant Cu atoms. Their splittings yield the magnitude and spatial shape of the conduction electron spin magnetization. One shell of neighbors to Ni, one to V, three to Co, five to Cr and Fe, and six to Mn were seen. The satellite in CuNi was studied at liquid helium temperatures in fields from 6 to 60 kG and those in CuCo from 1.5 to 450°K and 6 to 63 kG. CuV was studied from 8 to 63 kG at liquid helium temperatures, CuCr and CuMn from 7 to 15 kG at 300°K, and CuFe from 7 to 61 kG and 77 to 330°K. The satellite positions are independent of concentration from about 500 to 5000 ppM. The usual theoretical expressions for spin density are evaluated far from the impurity, where they depend only on the electrons at the Fermi surface. In contrast, to treat the near neighbors a d-wave phase shift analysis was developed in which conduction electrons of all energies are included to fit the experimental splittings in both the magnetic and non-magnetic cases. (auth)

16359 SINGLE CRYSTAL STUDY OF HYPERFINE FIELDS IN Fe-3.2 at.% Mo. Asano, A.; Schwartz, L. H. (Northwestern Univ., Evanston, IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 262-266(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Mössbauer spectra from single crystal Fe-3.2 at.% Mo were obtained with magnetization axes in the $(01\bar{1})$ plane along [100], [111] and intermediate directions. The complex spectra may be characterized by satellites whose appearance is greatly influenced by magnetization direction—one satellite with magnetization along [100], while two are clearly discernible with magnetization along [111]. A new deconvolution technique was used to eliminate thickness broadening. Analysis based on a pseudo dipole model yielded effective impurity induced dipole moments of −0.16 and −0.14 mm/s on the Fe atoms which are respectively first and second neighbors of Mo. The application of this analysis to the spectra for intermediate magnetization axes allows a test of the pseudo dipole model. (auth)

16360 ANALYSIS OF MOESSBAUER ^{57}Fe ABSORPTION IN AN F. C. C. Fe-Co-V ALLOY. Bambakidis, G.; Cusick, J. P. (Lewis Research Center, Cleveland). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 324-328(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Mössbauer ^{57}Fe absorption spectra of superparamagnetic fcc $Fe_{.34}Co_{.52}V_{.14}$ (Vicalloy II) have been analyzed using a cluster model and magnetic resonance relaxation theory. A least-squares fit to the spectrum at 4.2°K gives H_{hyp} = 175. kG, substantially greater than the value 55 kG inferred just from the observed broadening of the single-line spectrum. From this broadening an estimate of 40 kG is obtained for the width of the distribution in H_{hyp} at 4.2°K arising from compositional fluctuations and small-cluster effects. The model can be applied to unresolved or poorly resolved Mössbauer spectra in superparamagnetic multicomponent single-phase alloys of arbitrary composition. (auth)

16361 MAGNETIC PROPERTIES OF UCu_5 AND UNi_5. Brodsky, M. B. (Argonne National Lab., IL); Bridger, N. J. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 357-361(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

The magnetic susceptibilities and electrical resistivities of isostructural UCu_5 and UNi_5 have been measured between 2 and 300°K. While UCu_5 is antiferromagnetic at $T_N = 16 \pm 1$°K, and $p_{eff} = 2.3\ \mu_B$, UNi_5 has a nearly temperature independent susceptibility. Apparently, non-stoichiometry of the samples causes some uncertainties in the results. The occurrence of long-range magnetic order in UCu_5 is explained by the large U-U distance which prevents 5f-level broadening due to direct f-f overlap. The lack of magnetic order in UNi_5 may be due to d-f hybridization which causes sufficient 5f-level broadening and no magnetic order. (auth)

16362 MAGNETIC PROPERTIES OF Gd-RICH Gd-Sm ALLOYS. Arajs, S.; Adour, D. L.; Anderson, E. E.; DeYoung, T. F.; Rao, K. V. (Clarkson Coll. of Tech., Potsdam, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 362-365(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Ferromagnetic Curie temperatures (T_c) of Gd alloys containing 5, 10, 20, 25, 30, and 35 at.% Sm have been determined using the $d\rho/dT$ method, where ρ is the electrical resistivity. It has been found that this technique is consistent with the kink-point method and conventional magnetization vs internal field extrapolations. The effect of Sm on T_c of Gd is nonlinear, the initial decrease (up to about 5 at.% Sm) being only 0.4°K/at.% Sm. The decrease in the mass magnetization of the ferromagnetic alloys due to the addition of Sm in Gd is qualitatively similar to the T_c vs concentration dependence. (auth)

16363 MAGNETIC PROPERTIES OF $NpAl_3$. Aldred, A. T.; Dunlap, B. D.; Lam, D. J. (Argonne National Lab., IL). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 366-370(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

The magnetic properties of $NpAl_3$ were studied by means of magnetization and Mössbauer-effect measurements between 4 and 300°K. This compound, which has the $AuCu_3$-type structure with a lattice parameter of a = 4.260 Å, orders ferromagnetically at 62.5 ± 0.5°K. The magnetization cannot be saturated by an applied field of 13.5 kOe at 4°K. However, the ^{237}Np magnetic hyperfine field of 2630 kOe measured at 4.2°K indicates an Np magnetic moment of ~1.2 μ_B. Although the magnetic susceptibility above T_c deviates strongly from Curie-Weiss behavior, the temperature dependence can be reasonably well produced theoretically if it is assumed that the neptunium ion has a +4 charge ($5f^1$) and is situated in a cubic crystal field of 12 negatively charged ligands. (auth)

16364 NUCLEAR POLARIZATION DEPENDENCE OF COHERENT NEUTRON SCATTERING FROM HOLMIUM. Little, G. R.; Erickson, R. A. (Ohio State Univ., Columbus). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 411-415(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Neutron diffraction measurements with unpolarized neutrons have been made on a single crystal of Ho in the temperature range 4.2 to 0.4°K with the aim of studying the change in coherent scattering produced by the hfs-induced polarization of the Ho nuclear spins. It was found that the magnetic satellite reflections decrease linearly with nuclear polarization, but that no effect could be seen on the ordinary hexagonal reflections. The incoherent scattering amplitude was found to be $b_{inc} = -0.086 \pm .008 \times 10^{-12}$cm. The magnetic structure reported by Koehler et al., [Phys. Rev., 151:414(1966)] was confirmed except for the spin bunching parameter δ which was $\delta = 8.3°$ where Koehler found $\delta = 5.8°$. Since $\delta = 0°$ represents complete bunching, results of measurements suggest that the magnetic anisotropy does not affect the magnetic structure as much as Koehler suggests. Using the Ho coherent scattering amplitude $b_{coh} = 0.85 \times 10^{-12}$ cm it is found that the two compound nucleus scattering amplitudes are $b+ = +0.70 \pm .04 \times 10^{-12}$ cm and $b- = +1.04 \pm .04 \times 10^{-12}$ cm. (auth)

16365 TEMPERATURE DEPENDENCE OF THE Co HYPERFINE FIELD IN $GdCo_2$ AND ITS RELATION TO MAGNETIC STRUCTURE. Wang, I. (Fordham Univ., Bronx, NY); Burch, T. J.; Budnick, J. I.; Murphy, J. J.; Cannon, J. A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 437-441(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

To understand more fully the magnetic structure of $GdCo_2$ the field and temperature dependence of the Co hyperfine field in this cubic-Laves phase ferrimagnet were measured. The hyperfine field at Co nuclei is 61.3 kOe at 1.4°K and the sign of this field is positive with respect to the sample magnetization. Below 200°K the Co resonance is basically a single line. Above this temperature, near which a pronounced inflection appears in the saturation magnetization vs. temperature curve, the Co spectrum becomes complex. Above 260°K it is composed of two closely spaced but resolved lines. The temperature dependence of the sublattice magnetizations is analyzed in the light of the bulk magnetization behavior and this hyperfine field data. The significance of the spectral structure and the temperature dependence of the Co sublattice magnetization are explored within the context of existing models of the magnetic structure. (auth)

16366 CORRELATION BETWEEN LATTICE CONSTANT AND MAGNETIC MOMENT IN 3d TRANSITION METAL ALLOYS. Shiga, M. (Kyoto Univ.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 463-477(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

An empirical relation between the lattice constant and the magnetic moment was found in binary solid solutions of 3d transition metals expressed as $a(x) = a_A(1-x) + a_B x + C\langle|\mu|\rangle$, where x is the atomic fraction, a_A, a_B and C are parameters, $\langle|\mu|\rangle$ the average magnitude of atomic magnetic moments. It is shown that the equation holds for all possible combinations of 3d transition metals which form solid solutions over a considerably wide range of concentrations. The analysis of lattice constants at high temperatures leads to the conclusion that localized atomic moments are retained above Tc in most 3d ferromagnetic alloys. The thermal expansion anomaly observed in the Invar alloy ($Fe_{65}Ni_{35}$) is explained as the result of collapse of localized moments above Tc. The physical meanings of the parameters are discussed in terms of the atomic size. It is shown that expansion of the atomic size is caused by the formation of the localized moment. (auth)

16367 MAGNETIC PROPERTIES OF SOME SIMPLE METALLIC AND SEMIMETALLIC COMPOUNDS OF f-ELECTRON METALS WITH MAIN GROUP ELEMENTS. Stalinski, B. (Inst. for Low Temperature and Structure Research, Wroclaw). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 490-504(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Experimental work is reviewed, which was performed recently on the magnetic properties of rare earth and uranium compounds with main group elements. The results of low-temperature magnetic measurements carried out for Ce, Pr, Nd, Sm, Eu, Gd, and Yb compounds with In, Tl, Sn, and Pb ($AuCu_3$ or $CdMg_3$ type of structure) as well as for uranium compounds with main group elements ($AuCu_3$ type of structure) are reported. Also, magnetic data for uranium compounds of the form UXY, $U_2N_2X(Y)$, and U_3Y_5 as well as for UX-UY solid solutions (where X = element of group V, and Y = element of group VI) are included. (auth)

16368 STUDIES OF RARE EARTH COBALTITES, $La_{1-x}Sr_xCoO_3$. Rao, C. N. R. (Indian Inst. of Tech., Kanpur, India); Bhide, V. G. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 504-512(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

In rare earth cobaltites, the cobalt ions are present mainly in the diamagnetic low-spin Co^{III} state at low temperatures. The Co^{III} ions transform to high-spin Co^{3+} ions with increase in temperature. At higher temperatures, there is electron-transfer from Co^{3+} to Co^{III} ions producing intermediate states. Spin-state transitions are seen in these cobaltites in the range 250 to 870°K. At very high temperatures, the cobaltites show evidence for localized-itinerant electron transitions. In $La_{1-x}Sr_xCoO_3$, there is onset of ferromagnetism at $x > 0.125$, at which point there is a structural discontinuity and electrons become itinerant. The composition with x = 0.5 is metallic and $T_c = 230$°K. The ferromagnetic component in $La_{1-x}Sr_xCoO_3$ increases with x in the range 0.125 to 0.50. In $LaCo_{1-x}Fe_xO_3$, the iron ions are always present in the high-spin state and the d-electrons get more localized with increase in x. Effect of substitution by ions such as Th^{4+} and Ni^{3+} in $LaCoO_3$ has also been examined. Catalytic properties of rare earth cobaltites appear to be related to the spin state equilibria. (auth)

16369 MAGNETISM IN AMORPHOUS TERBIUM-IRON. Rhyne, J. J.; Pickart, S. J.; Alperin, H. A. (Naval Ordnance Lab., Silver Spring, MD). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 563-577(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Neutron diffraction and magnetization measurements on a sputtered specimen of 33% terbium, 66% iron have confirmed the existence of long range magnetic order and an amorphous spatial distribution of atoms and spin sites. Elastic diffraction data taken above and below the 409°K Curie temperature have enabled the separation of nuclear and magnetic scattering contributions. The magnetic spin density function contains a very broad major peak, dominated by the Tb–Tb pair distribution function, with a maximum near 3.6 Å. Longer range correlations are very much weaker. The principal features of the atomic structure can be accounted for by considering only near neighbor correlations between terbium and iron atoms in a random close-packed arrangement. Inelastic scattering studies have revealed a significant shift in the magnetic density of states to lower energy in the amorphous material relative to the crystalline $TbFe_2$ counterpart. No discrete spin-wave excitations or critical scattering near T_c could be observed. (auth)

16370 MOESSBAUER EFFECT STUDIES IN AMORPHOUS $TbFe_2$, $DyFe_2$, $HoFe_2$, AND $ErFe_2$. Sarkar, D. (American Univ., Washington, DC); Segnan, R.; Clark, A. E. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 636-640(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Mössbauer measurements have been performed on sputtered $TbFe_2$, $DyFe_2$, $HoFe_2$ and $ErFe_2$. Neutron diffraction data indicates that sputtered $TbFe_2$ is structurally and magnetically amorphous. At room temperature, sputtered $TbFe_2$ exhibits a Mössbauer pattern which is interpreted as due to a broad distribution of hyperfine fields. A similar distribution of hyperfine fields is observed in $DyFe_2$ and $HoFe_2$ at 77°K. $DyFe_2$, $HoFe_2$, and $ErFe_2$ show a resolved doublet at room temperature due to well defined quadrupolar interaction at the iron nuclei. Low temperature measurements on sputtered $HoFe_2$ show the broad pattern at 145°K and the quadrupolar doublet at 230°K. The data indicate that the iron moments experience an exchange field of random orientation and magnitude and that the crystal field on the iron ions is relatively uniform. (auth)

16371 ELECTRICAL RESISTIVITIES OF THE INTERMETALLIC COMPOUNDS $NpRu_2$ AND $NpOs_2$. Harvey, A. R. (Argonne National Lab., IL). Solid State Commun.; 14: No. 12, 1291-1294(15 Jun 1974).

The electrical resistivities of the cubic intermetallic compounds $NpRu_2$ and $NpOs_2$ were measured in the temperature range 1.5 to 300°K. The resistivity of $NpRu_2$ varies as T^2 up to 13°K. This behavior is in agreement with the predictions of the localized-spin-fluctuation model. The resistivity–temperature curve of $NpOs_2$ has the characteristics of a material that orders magnetically. The ordering temperature $T_C = (7.4 \pm 0.5)$°K was obtained from an analysis of the data. The difference between the magnetic properties of $NpRu_2$ and $NpOs_2$ is discussed in terms of the variation in the actinide–actinide interatomic distance in these compounds. (auth)

16372 CONTRIBUTION TO THE MAGNETIC PROPERTIES OF THE RCo_5 INTERMETALLIC COMPOUNDS. Dworschak, G.; Khan, Y. (Bochum Univ., Ger.). J. Phys. Chem. Solids; 35: No. 8, 1021-1022(Aug 1974).

Investigations were carried out in order to understand the sources of easy domain-wall nucleation in the RCo_5 permanent magnets. The method of fabricating and heat treating the alloys is described. Chemical analysis was carried out with an x-ray fluorescence spectrometer. X-ray diffraction analysis was also undertaken. Magnetic measurements were made on polycrystalline powder samples, with a pulse-field magnetometer. The variation of lattice parameters with composition of $CeCo_5$ is shown. The dependence of saturation magnetization and magneto-crystalline anisotropy field upon the Co content of the $CeCo_5$ compound is shown. Results are discussed. (UK)

16373 ELECTRONIC ENERGY LEVELS OF HYDROGEN ADSORBED ON TUNGSTEN. Feuerbacher, B.; Fitton, B. (European Space Research Organization, Noordwijk, Netherlands). Phys. Rev., B; 8: No. 10, 4890-4892(15 Nov 1973).

The electronic energy levels of hydrogen adsorbed on three low-index planes of tungsten have been studied by a directional photoemission technique for coverages between 0.01 and 1 monolayer. A number of relatively sharp resonance levels are observed, which show half-widths down to 0.5 eV. For the (100) face, a single high-coverage state evolves from multiple low-coverage states, while on the (110) face two states appear to build up sequentially. No pronounced coverage dependence is observed for the (111) face. (auth)

16374 ADSORPTION OF W ON W(110): WORK-FUNCTION REDUCTION AND ISLAND FORMATION. Besocke, K.; Wagner, H. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev., B; 8: No. 10, 4597-4600(15 Nov 1973).

Work-function changes up to 0.6 eV were observed during the adsorption of W on a (110) W single-crystal surface for coverages below one monolayer. It is concluded that this is due to a varying structural arrangement of atoms in the outermost surface layer. Atoms in adpositions and ledge positions on their own lattice exhibit electric dipole moments causing work-function reductions with respect to the ideally flat surface. (auth)

16375 MAGNETIC INVESTIGATION ON AlB_2 TYPE STRUCTURES. Narasimhan, K. S. V. L.; Steinfink, H. (Univ. of Texas, Austin). J. Solid State Chem.; 10: No. 2, 137-141(Jun 1974).

Magnetic measurements over 6 to 630°K show that the effective paramagnetic moments in Gd_3Si_5, Dy_3Si_5, and Tb_3Si_5 are those of the tripositive rare-earth ions, and these materials are either antiferromagnets or have spiral configurations. In $NdSi_{1.6}Ni_{0.4}$, the effective magnetic moment is due to Nd^{+3} only. $NdSi_{1.6}Fe_{0.4}$ shows a complex magnetic structure. $LaSi_{1.6}Ni_{0.4}$ and $LaSi_{1.6}Fe_{0.4}$ are Pauli paramagnets. (5 figures) (auth)

16376 MAGNETISM IN ALLOYS. Symposium Held in Boston, Massachusetts, May 10, 1972. Beck, P. A.; Waber, J. T. (eds.). New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1972). 250p. (CONF-7205109-).

Seven papers were presented at the symposium. A separate abstract was prepared for each of four papers selected for inclusion in NSA. Papers for which no abstracts were prepared are concerned with properties of solutes in metals, ferromagnetism, and mictomagnetism. (JRD)

For abstracts of individual papers see: 16230 and 16377–16379.

16377 INTRODUCTORY REMARKS CONCERNING THE THEORY OF ALLOYS. Weber, J. T. (Northwestern Univ., Evanston, IL). pp 1-18 of Magnetism in Alloys. Beck, P. A. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and the Petroleum Engineers, Inc. (1972).

From magnetism in alloys symposium; Boston, Massachusetts, USA (10 May 1972). See CONF-7205109-.

A review of basic concepts underlying historical developments concerned with the origin of magnetism in metals and alloys is presented. It is noted that the old controversy between proponents of the localized (Heisenberg–Van Vleck) view and the itinerant Stoner–Slater (band) picture has subsided though it is still not resolved. At the moment some modified forms of the band picture are the most accepted view. Several developments concerning the source of the exchange integral J have been noted. But the distinctions of whether it arises from localized or from itinerant electrons have become blurred with increasing time. (JLD)

16378 EFFECTS OF LOCAL ATOMIC ENVIRONMENT IN CONCENTRATED MAGNETIC ALLOYS. Garland, J. W.; Gonis, A. (Univ. of Illinois, Chicago). pp 79-162 of Magnetism in Alloys. Beck, P. A. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1972).

From magnetism in alloys symposium; Boston, Massachusetts, USA (10 May 1972). See CONF-7205109-.

The effects of local environment on the magnetic state of an atom are shown to dominate the determination of the magnetic properties of many concentrated transition-metal alloys. Experimental evidence suggestive of such local environment effects is presented for several different types of alloys. Difficulties in distinguishing between band and local effects are pointed out. The phenomenological models suggested by this experimental evidence are reviewed and compared with microscopic theoretical models. The theoretical models are shown to allow the possibility of cooperative effects. A preliminary analysis of magnetization and neutron diffraction results for concentrated Ni–Cu alloys suggests that such effects, neglected in previous phenomenological models, are important in some cases. The recent relevant theoretical literature, as well as some research in progress, is surveyed. (auth)

16379 LONG RANGE MAGNETIC ORDER IN DISORDERED ALLOYS: ANTIFERROMAGNETISM. Arrott, A. S. (Simon Fraser Univ., Burnaby, British Columbia). pp 187-210 of Magnetism in Alloys. Beck, P. A. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1972).

From magnetism in alloys symposium; Boston, Massachusetts, USA (10 May 1972). See CONF-7205109-.

The basic information to be obtained from systems with long range magnetic order is the set of fourier components of the magnetization. For studying the onset of long range order the impor-

tant quantity is the wavevector-dependent susceptibility. These quantities are obtained by neutron diffraction studies. It is the goal of theories to explain these quantities. These concepts are discussed in reference to the fcc antiferromagnetic alloys of the first transition series metals, particularly Fe–Mn alloys. Other properties are summarized. References are given to recent work on bcc Cr alloys and on α-Mn. The purposes of studying antiferromagnetism in alloys are discussed. (auth)

16380 MULTIPLICATION OF DISLOCATIONS IN Mo THIN FOILS. Vesely, D. pp 189–194 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From 3rd international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

The low temperature behavior of bcc metals is characterized by a large increase in flow stress and complex slip geometry. It is generally accepted that the thermally activated motion of screw dislocations is responsible for the low-temperature behavior. In Mo, which shows low-temperature behavior at 293°K, the low-strain (stage 0) slip geometry is different from that at higher strains (stage 1). This has been explained by a change in mobility of screw dislocations and their influence on dislocation multiplication. It was concluded later that the mechanism of multiplication must be changed in stage 1. However, the detailed mechanism of dislocation multiplication is not known and an attempt is made in the present work to find out how a change in stress level can change the mechanism of dislocation multiplication and what is the role of screw dislocations. The present results show that two types of screw dislocations move on planes with very low Schmid factors (0.2); both types of dislocations are equally stressed having Burgers vectors $a/2$ [111] and $a/2$ [$\bar{1}$11]. Movement of screw dislocations was observed from the start of plastic deformation. The dislocation sources observed in Mo at low stress levels are detailed. An attempt was made to analyze the pinning points using stereo-pair analysis and Burgers-vector determinations. Dislocation tangles were observed to form on one side of a source only. Even in the later stages of deformation this relationship between sources and tangles still persisted so that throughout the deformation the number of sources was directly related to the number of tangles. The choice of slip plane is not yet clear. The fact that the slip plane is always nearly perpendicular to the surface indicates that the image forces are important for either the movement of screw dislocations or the formation of pinning points. Some detailed calculations to evaluate the role of image forces are necessary. The main difference between thin foils and bulk specimens is that primary slip predominate in stage 1 deformation of bulk specimens; in thin foils, however, the slip systems are not changed even when a crack propagates through the foil; facets parallel to the slip planes are formed on the fracture surface. This means that the surface has a greater influence on the choice of slip systems in thin foils than in the bulk material. (UK)

16381 SPIN-ORBIT-INDUCED SURFACE RESONANCE ON TUNGSTEN. Sturm, K.; Feder, R. (Kernforschungsanlage Juelich GmbH, Ger.). Solid State Commun.; 14: No. 12, 1317-1320(15 Jun 1974).

A three-band model tight binding Greens function formalism is used to calculate the electronic structure of the (100) surface of tungsten in the vicinity of the Fermi level. Results exhibit a large surface resonance, which provides an explanation for a surface-sensitive peak observed in recent field- and photoemission experiments. (auth)

16382 TRUE SPECIFIC HEAT OF VANADIUM IN THE TEMPERATURE RANGE 300 TO 900°K. Chekhovskoi, V. Ya.; Kalinkina, R. G. (Inst. of High Temperature, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 4, 796-797(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 4, 885–886(1973).

The true specific heat of V was measured in an inert medium by the continuous-heating method. The specific heat varies from 0.1140 kcal/kg·degree at 307°K to 0.1339 kcal/kg·degree at 891.5°K. (DLC)

16383 MICROSTRUCTURE AND MAGNETIC PROPERTIES OF $SmCo_5$–$SmCu_5$ CAST ALLOYS. Song, J. T. J. Korean Inst. Metals; 11: No. 3, 231-237(1973).

In order to correlate the microstructure and magnetic properties, the effect of composition and aging treatment on the magnetic properties of the alloy system $SmCo_5$–$SmCu_5$ were studied. A number of ingots of the ternary composition $SmCo_{5-x}Cu_x$ (x = 1 to 4) were prepared by arc-melting under a protective atmosphere, resulting in a rapid freezing from the molten state. The samples were then annealed at various temperatures between 400 and 1000°C. The magnetic properties of these compounds were the highest in the vicinity of the composition $SmCo_{3.5}Cu_{1.5}$ and $SmCo_{3.0}Cu_{2.0}$. When specimens of the composition $SmCo_{3.5}Cu_{1.5}$ annealed at 1000 and 400°C were examined by optical microscope, x-ray diffraction, and electron-probe techniques, there were observed fine needle-shaped precipitates which may be responsible for the magnetic hardening of this compound. Their hexagonal cell constants (a = 8.402A, c = 12.172A) were obtained from FeKα powder diffraction data. Results indicate that precipitates occurring at the low temperature annealing are the same kind of phase as Sm_2Co_{17} precipitates at the high temperature annealing, and they appear to overage rapidly during the annealing between 400 and 600°C. Therefore, annealing at the high temperature over 600°C does not lead to a further increase in the magnetic properties of $SmCo_{5-x}Cu_x$ alloys. (Korean Sci. Abstr.)

16384 ELECTRIC TRANSPORT PROPERTIES OF HIGH PURITY METALS AND THE INFLUENCE OF TRACE IMPURITIES. Wenzl, H.; Welter, J. M. (Kernforschungsanlage, Juelich, Ger.). Z. Metallk.; 65: No. 3, 205-214(Mar 1974). (In German).

The electronic transport coefficients of pure metals are discussed, especially in their relation to trace impurities: residual resistivity, residual resistivity ratio, thermal conductivity, thermoelectric force, Hall effect, magnetoresistance. A series of examples demonstrates the abilities of the transport coefficients in the field of trace analysis. Average impurity concentrations in the ppM range can be determined easily by resistivity measurements. Further specifications of the impurities are obtained from the other coefficients. A few examples of technical application are mentioned. (GE)

16385 STRENGTHENING OF COBALT ALLOYS CONTAINING 22 WT.% Ni–22 WT.% Cr–15 WT.% W AT ROOM TEMPERATURE AND ELEVATED TEMPERATURES. Schubert, F. (Deutsche Edelstahlwerke AG, Krefeld, Ger.). Z. Metallk.; 65: No. 3, 226-230(Mar 1974). (In German).

Cobalt alloys containing 22 wt % Ni, 22 wt % Cr, and 15 wt % W may be strenghthened considerably by thermal-mechanical treatment (at room temperature: $\sigma_{0.2}$ = 2,300 N/mm², σ_B = 2,450 N/mm²). Two experimental melts were employed to study the influence of deformation at room temperature and at elevated temperatures with and without subsequent heat treatment on the tensile properties. The high increase in strength is caused by the strain-induced formation of areas of the ε phase whose volume fraction increases further on subsequent heat treatment at 500 to 600°C. This increase in strength is effective up to temperatures of about 600°C. Thus, this oxidation resistant alloy may be used for structural parts which require high strengths up to 600°C. (GE)

Radiation Effects

Refer also to abstracts 16138, 17382, 17471, and 17693.

16386 (CONF-700347-, pp vp, Paper 16) EVALUATION BY LINEAR ELASTIC FRACTURE MECHANICS OF RADIATION DAMAGE TO PRESSURE VESSEL STEELS. Mager, T. R. (Westinghouse Electric Corp., Pittsburgh). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The critical stress intensity factors K_{Ic} (fracture toughness) were determined from 1-in.-thick fracture mechanics specimens after exposure to a fluence of 1.3 to 5.5 × 10^{19} neutrons/cm² (E > 1 MeV) at about 550°F. The fracture mechanics specimens were fabricated from the top surface, quarter-thickness, and center region of HSST plate 02. Tensiles and Charpy V-notch specimens fabricated from the same locations were also evaluated. The shift in fracture toughness of the material after the neutron exposure was approximately the same as the 30-ft-lb fix Charpy transition temperature shift. Two-inch-thick fracture mechanics specimens fabricated from the center region of HSST plate 02 are currently in-pile at the Babcock and Wilcox Test Reactors. The irradiation of the 2T compact K_{Ic} specimens will continue through April 1970, at which time the specimens will have seen an approximate fluence of 5 × 10^{19} neutrons/cm². As with the 1-in-thick specimens, the 2-in.-thick specimens are being irradiated at 550°F. (auth)

16387 (CONF-700347-, pp vp, Paper 17) FRACTURE PROPERTIES OF A PRESSURE VESSEL STEEL: NEUTRON IRRADIATED A533B. Hunter, C. W.; Williams, J. A.; Hellerich, C. L. (Pacific Northwest Lab., Richland, WA). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The studies at Pacific Northwest Laboratory in support of the HSST Program are principally concerned with determining the effect of neutron embrittlement on the fracture toughness K_{Ic} of heavy section plate and weldment. The materials currently being studied are the 12-in.-thick A 533 grade B, class 1 program plate

02 and 12-in. submerged-arc weldment. One-inch fracture mechanics (1-T CT) specimens and tensile specimens have been irradiated in the ETR. The total irradiations completed to date include 12 CT specimens of base materials and 12 CT specimens of weld and heat affected zone to a fluence of 1.5 to 2.5×10^{19} neutrons/cm^2 (E > 1 MeV), 4 CT specimens of base material at 7 to 8×10^{19} and 64 tensile specimens ranging from 1.5 to 8×10^{19}. The tensile specimens were irradiated at 510°F and CT specimens at 540°F. Approximately one-third of these specimens have been tested. The yield strength increase was 40 to 45% at 2×10^{19} and 50 to 55% at 4.4×10^{19}. The K_{Ic} data at 2×10^{19} indicate that the embrittlement was equivalent to a 170°F decrease in test temperature. Postirradiation annealing of some tensile specimens was conducted at 540, 600, 650, and 725°F. The reduction of the irradiation hardening commenced above 540°F and was 70% complete by 650°F, but was not further reduced at 725°F. Based upon the irradiated K_{Ic} and tensile data, it may be estimated that 4-T CT specimens will yield valid K_{Ic} values of greater than 110,000 psi $\sqrt{\text{in.}}$ at 200 to 300°F. Experimental gamma heat determinations in the ETR revealed that the temperature gradient in a 4-T irradiation would be too great; therefore, large reflector positions in the ATR have been selected for the 4-T irradiation facility. With two independent subcapsules, the 550°F irradiation of two transverse (WR) orientation base plate specimens at 6×10^{19}, four WR and four longitudinal (RW) orientation base plate specimens at 1.2×10^{19}, and two weld specimens at 1.2×10^{19} are planned. (auth)

16388 (CONF-700347-, pp vp, Paper 18) IMPROVED RADIATION EMBRITTLEMENT RESISTANCE IN COMMERCIALLY PRODUCED A533B PLATE AND WELD METAL. Hawthorne, J. R. (U. S. Naval Research Lab., Washington, DC). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Wide differences in radiation embrittlement susceptibility have been a common observation for commercially produced A 533 steel plate and weld deposits. Available data suggest that the radiation sensitivity of HSST plate 01 is but a high average of two broad extremes. Studies of factors responsible for sensitivity variations revealed the major influence of residual element content on elevated temperature irradiation response. Laboratory melts of A 302B and Ni–Cr–Mo steels also demonstrated that excellent resistance to radiation embrittlement at 550°F was attainable in small (300 lb) quantities with sufficient purity. Detailed investigations of residual element contributions identified copper and phosphorus as highly detrimental to radiation embrittlement resistance. The desirability of transferring laboratory-scale findings to commercial practice has led to scaleup demonstration tests of the producibility of improved plate and weld metals. A 30-ton A 533B steel heat melted to NRL specified maximums on various residual elements represents one highly successful demonstration test. The special melt, undertaken at the request of the U. S. Atomic Energy Commission, was intended to depict the present capabilities of industry to match the low 550°F radiation embrittlement sensitivity developed in small laboratory melts. Ladle analyses of the melt indicated 0.03% copper and 0.006% phosphorus contents. Copper was added to one of two ingots to develop a direct comparison of the effects of high (0.13%) and low copper content. Initial radiation assessments of 6-in.-thick test plates (class 1 and class 2 heat treatment conditions) have been completed. The relative radiation embrittlement sensitivity of low-copper-content plates was less than that of the ASTM A 302B reference plate; the average 30-ft-lb transition temperature increase for a fluence of $\sim 2.8 \times 10^{19}$ neutrons/cm^2 > 1 MeV at 550°F was 50°F. By comparison, plates containing 0.13% copper exhibited transition temperature increases of 125 to 140°F. Other recent scaleup demonstrations involve thick section A 533B weldments. A 0.09% Cu, 0.002% P class 1 electroslag weld comprised a second example of improved radiation embrittlement resistance of a commercial product by "specification." Transition temperature increase for the controlled composition weld was only half that of typical commercial electroslag welds examined earlier. Recent results for HSST plates 01 and 02 will be presented and compared with results for other commercial products and results for the scaleup demonstration melt. (auth)

16389 (CONF-700347-, pp vp, Paper 19) RADIATION STUDIES ON HSST PLATE AND WELDS. Berggren, R. G.; Stelzman, W. J.; Jones, T. N. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

Additional data on the radiation-induced changes of tensile and notch-impact properties of 12-in.-thick ASTM A 533 grade B, class 1 steel HSST plates 01 and 02 have been obtained recently. Specimens from a submerged-arc weldment 12 in. thick were irradiated at 150, 450, and 550°F, and specimens from an electroslag weldment 6 in. thick were irradiated at 150 and 550°F. All irradiations approached neutron fluences of about (±50%) 1×10^{19} neutrons/cm^2 (E > 1 MeV). Some results for the submerged-arc weldment irradiated at 150 and 450°F have been obtained with testing for the others in progress. (auth)

16390 (CONF-700347-, pp vp, Paper 20) THROUGH THICKNESS TRANSITION TEMPERATURE OF IRRADIATED THICK WALL NUCLEAR PRESSURE VESSELS. Canonico, D. A. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

The operation of nuclear power plants is governed by the properties of their pressure vessels. Of particular concern is the ductile-to-brittle transition temperature of the steel from which the vessel is fabricated and how this property is affected by irradiation. Currently, all light-water nuclear pressure vessels are fabricated from thick-section (6 to 12 in.) low-alloy, high-strength steels. Pressure vessel design requires that these steels be quenched and tempered in order to achieve optimum mechanical properties. Quenching these section sizes results in a through-the-thickness variation in mechanical properties. For 12-in.-thick ASTM A 533 grade B, class 1 steel, the 30-ft-lb Charpy V temperature varies from about –150°F at the surface to about +10°F at the ¼-thickness location (1½ in. below the surface). Section III of the ASME Code requires that test specimens be taken from the ¼-thickness location (3 in. below the surface), and, consequently, the property variation is not considered. In order to determine the effect of a lifetime irradiation dose (usually in excess of 3×10^{18} neutrons/cm^2, E > 1 MeV), surveillance specimens taken from the ¼-thickness location are employed. These specimens have a preirradiation 30-ft-lb Charpy V temperature of about +10°F. Irradiating them at 550°F to a fluence of 6×10^{19} neutrons/cm^2 (E > 1 MeV) should result in a 30-ft-lb Charpy V temperature of about 210°F. This approach to the effect of irradiation ignores two facts: (1) the maximum dose is imposed on the inner surface and (2) the thick-walled steel is self-shielding. The steel which receives the maximum fluence (the inner surface) has an initial 30-ft-lb Charpy V temperature of about –150°F, and, assuming a 200°F shift due to irradiation, its end-of-life 30-ft-lb Charpy V temperature will be 50°F. The steel at the ¼-thickness location does have a 30-ft-lb Charpy V temperature of +10°F; however, in practice, it is self-shielded to the extent that it is exposed to a fluence approximately one-fourth of that of the inner wall. This self-shielding in association with the variation in Charpy V properties through the thickness results in the maximum 30-ft-lb Charpy V temperature occurring between the 1- and 2-in. thickness level. This temperature for the 12-in.-thick HSST plates irradiated at 550°F to an inner wall fluence of 6×10^{19} neutrons/cm^2 (E > 1 MeV) is about 140°F. The material in a nuclear pressure vessel that does not possess a through-the-thickness variation in toughness is the weld metal. It is, however, initially tougher than the base metal; it has a 30-ft-lb Charpy V temperature of –60°F vs +10°F for the base metal at the ¼-thickness location. When it is exposed to irradiation, its highest transition temperature will be at the inner wall, the location exposed to the maximum dose. However, there are data that indicate that weld metal can be more sensitive to irradiation than base plate and that its shift in transition temperature is higher than would be predicted from base-metal data. The self-shielding and variation of properties through the thickness of a nuclear pressure vessel imply that the radiation effects as currently predicted are on the conservative side and should provide some degree of comfort to the safety analyst. (auth)

16391 (HEDL-SA-657) REACTOR MATERIALS PERFORMANCE PREDICTIONS: A CRITIQUE OF DAMAGE FUNCTIONS ANALYSIS. Odette, G. R.; Simons, R. L.; McElroy, W. N. (California Univ., Santa Barbara (USA); Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1974. 28p. (CONF-740651-2). Dep. NTIS $4.50.

From symposium on the effects of radiation on structural materials; Gatlinburg, Tennessee, USA (11 Jun 1974).

The utility and limitations of damage function analysis were investigated using computer experiments. Simulated irradiations in available neutron spectra based on simple damage models were used to study: the existence of damage functions; the uniqueness of damage function solutions; data error propagation; and procedures for combining various errors to provide a total lower fluence bound limit. The most important factor in damage function analysis was found to be the similarity and degree of spectral overlap between experimental spectra used to generate damage functions and the spectra in which they were applied. (auth)

16392 (HEDL-SA-654) SPECTRAL EFFECTS IN NEUTRON AND CHARGED PARTICLE IRRADIATIONS. Doran, D. G.; Simons, R. L.; McElroy, W. N. (Hanford Engineering Develop-

ment Lab., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2170. 32p. (CONF-740651-1). Dep. NTIS $4.75.

From symposium on the effects of radiation on structural materials; Gatlinburg, Tennessee, USA (11 Jun 1974).

The dependence of radiation damage in metals on the type and energy of the incident particle is considered. The calculation and use of displacement and point defect production as energy-dependent measures of exposure are described. A brief review is given of the quasi-empirical, energy-dependent damage function approach to determining the damaging effectiveness of different neutron spectra; included is a summary of derived effective damage functions and their dependence on or contribution to an understanding of damage mechanisms. Lastly, swelling rates of Type 316 stainless steel irradiated by neutrons, nickel ions, protons, and electrons are shown to correlate qualitatively with mobile vacancy production rates as deduced from computer modeling. (31 references) (auth)

16393 (INIS-mf-1125) HIGH TEMPERATURE NEUTRON INDUCED EMBRITTLEMENT OF DISPERSION-STRENGTHENED FERRITIC ALLOYS. van Asbroeck, P.; Vandermeulen, W.; Saykers, M.; Huet, J. J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1973. 10p. INIS.

From symposium on the results of five years of BR2 reactor utilization; Mol, Belgium (4 Dec 1973).

Dispersion-strengthened ferritic steels were irradiated simultaneously with several austenitic steels in the BR2 reactor up to a fluence of 1.6×10^{22} n/cm^2 at low temperature and to 2×10^{21} n/cm^2 at 700°C. Postirradiation testing at 700°C showed that dispersion-strengthened ferritic alloys have higher 700°C total elongation values than austenitic steels and their degree of embrittlement in the smallest; oxide dispersion is beneficial to the resistance to high-temperature embrittlement; and the use of powder metallurgy decreases the irradiation embrittlement. Results are explained by the temperature at which grain boundary cracking first appears. (auth)

16394 (JUL-1010-RG) INVESTIGATIONS ON BeO. Hecker, R. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Oct 1973. 164p. (In German). Dep. NTIS (US Sales Only) $11.25.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The nuclear advantages of BeO as a moderator in high temperature reactors are described along with the difficulties, which have so far prevented the use of this material. The main problems are the removal of the reactor poison ^{6}Li, produced by the reaction ^{9}Be(n,α)^{6}He → ^{6}Li, and the radiation damage of BeO by fast neutrons, which reduces the mechanical stability of the fuel elements and has made economic service life in power reactors impossible so far. In addition reactor- and neutron physics experiments to get nuclear data of BeO and the diffusion behavior of lithium in BeO are reported. (GE)

16395 (KHFTI-72-45, pp 8-12) EXCITATION OF ULTRASONIC WAVES IN SOLIDS WITH AN ACCELERATED ELECTRON BEAM. Borzhkovskii, I. A.; Volovik, V. D.; Grishaev, I. A.; Zalyubovskii, I. I.; Petrenko, V. V.; Fursov, G. L. 1972. (In Russian).

The experimental methods used and the results obtained in the study of the excitation of ultrasonic oscillations during passage of electrons with energy <<225 MeV through duralumin foils were described. The studies were made at frequencies of 65.0 kHz with pass bands of all detecting channels of 4.0 kHz. The results of the measurement of the amplitude of the ultrasonic oscillations as a function of the total number of electrons detected in current sending of the accelerator during passage of the electrons through different materials with the same thickness were reported. It was assumed that the basic source of the ultrasonic oscillations is the coherent radiation electron energy loss. A scheme was proposed for the transformation of the particle energy loss. Since the signal amplitude is directly proportional to the number of particles in the sending, this effect can be used for measurement of weak and strong currents of charged particles and for the measurement of powerful currents of hard photons. (tr-auth)

16396 (LIB/Trans-526) RECOMMENDATIONS CONCERNING THE MEASUREMENTS OF IRRADIATION RECEIVED BY THE STRUCTURAL MATERIALS OF (ATOMIC) REACTORS. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). 1973. Translation of EUR-5035. 10p. Dep. NTIS (U. S. Sales Only) $4.00.

The measurement of irradiation received by reactor steels is considered. The energy imparted to the network (E_R) forms the measure of the flux received. Two other magnitudes, strictly proportional to E_R, can be used to express fluxes, the number of displaced atoms and the fission flux. (AT)

16397 (WARD-OX-3045-9) STRESS-INDUCED DEFECT MIGRATION TO SPHERICAL SINKS. Wolfer, W. G.; Ashkin, M. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jun 1974. Contract AT(11-1)-3045. 43p. AT.

Radiation damage in metals at elevated temperatures produces small dislocation loops and voids. The growth of these sinks is determined by the steady-state diffusion of point defects migrating in the stress field of these sinks. To obtain the steady-state current of point defects to these spherical sinks a perturbation method is developed to deal with the drift term of the diffusion equation. It is shown that the contribution of the drift term to the current can be expressed by a bias factor which differs from one if the point defects interact with the spherical sink. Explicit expressions of the bias factors for voids and infinitesimal dislocation loops are given. If the metal is subject to external loads the bias factors of voids depend on the elastic dilatation, whereas the bias factors for dislocation loops depend on the deviatoric elastic strain. These results then provide the basis for stress-induced swelling and irradiation creep of metals. Both of these phenomena are briefly discussed. (auth)

16398 (WARD-OX-3045-10) CREEP AND SWELLING DEFORMATION IN STRUCTURAL MATERIALS DURING FAST-NEUTRON IRRADIATION. Wolfer, W. G.; Ashkin, M.; Foster, J. P.; Biancheria, A.; Boltax, A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jun 1974. Contract AT(11-1)-3045. 34p. AT.

Radiation-induced creep and swelling is formulated in terms of the segregation of vacancies and interstitials to the microstructural sinks, such as voids, dislocations, and dislocation loops, in order to provide the physical basis for the effect of stress on swelling, radiation-induced creep, and the interrelationship between swelling and irradiation creep. It is first shown that the segregation is caused by the interaction between the point defects and the sinks, and that the size-interaction as well as the inhomogeneity-interaction have to be considered. The latter interaction depends both on the external and the internal stresses. The segregation is then expressed in terms of bias factors for each sink type, and these factors are given for voids, small dislocation loops and edge dislocation multipoles. The bias factors for voids are shown to depend on the hydrostatic stress leading to a stress-dependent incubation time for void nucleation as well as a stress-dependent swelling rate. The bias factors for dislocation loops depend on the deviatoric stress. Thus, the loop growth rate becomes orientation-dependent in a stress field, which gives rise to irradiation creep. The comparison between the bias factors of voids and dislocation multipoles reveals that void nucleation is suppressed in cold-worked materials until sufficient recovery has occurred. By including the bias factors for voids, dislocations, and dislocation loops into the models for swelling and irradiation creep, a constitutive law for radiation-induced deformation is obtained which includes the rates for stress-free swelling, stress-induced swelling, swelling-independent and swelling-dependent irradiation creep. It is shown that the measurement of residual stresses in irradiated fuel pin capsules support a constitutive equation of the proposed form. (auth)

16399 MICROSTRUCTURE OF NEUTRON-IRRADIATED COLD-WORKED STAINLESS-STEEL FUEL PIN CLADDING. Brager, H. R. (Westinghouse-Hanford, Richland, WA). Trans. Amer. Nucl. Soc.; 18: 107-108(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16400 SWELLING RESULTING FROM FAST-NEUTRON VS 5-MeV Ni^{2+} IRRADIATION OF COLD-WORKED 316 STAINLESS STEEL. Challenger, K. D.; Appleby, W. K. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 18: 108-109 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16401 PARTICLE RANGE AND ENERGY DEPOSITION IN MATERIALS CONTAINING VOIDS. Odette, G. R. (Univ. of California, Santa Barbara); Schwartz, D. M.; Ardell, A. J. Trans. Amer. Nucl. Soc.; 18: 109-110(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16402 CORROSION BEHAVIOR OF ALLOY 600 IN NUCLEAR ONCE-THROUGH STEAM GENERATOR SERVICE. Levstek, D. F. (Babcock and Wilcox Co., Lynchburg, VA); McNary, T. A. Trans. Amer. Nucl. Soc.; 18: 119(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16403 RADIATION HARDENING MECHANISM IN Fe-C-Mn TYPE ALLOYS. Brumovsky, M. (Skoda Works, Plzen, Czech.). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 46-62(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Radiation damage in Fe–C–Mn type alloys, chosen as a first approximation to low-carbon pressure vessel steels, was studied after irradiation at two temperature regions (80 to 100°C and 160 to 180°C). Effect of saturation and "oversaturation" (expressed by softening) on yield strength was confirmed. The effect depends on alloy structure and content of both alloy elements–carbon in the form of pearlite substantially increases the tendency to "oversaturation," while manganese shifts the saturation dose to higher values. For pure iron a saturation dose equal to about 4×10^{19} n/cm^2 ($E_n > 1$ MeV) was found. At the same time the presence of carbon results in the suppression of yield strength increase during irradiation, while manganese enhances this yield strength increase if more than approximately 0.5 wt % manganese is present. On the basis of the analysis of individual parameter changes in the model of radiation hardening in Fe–C–Mn type alloys, an explanation is proposed of the influence of neutron dose at irradiation temperatures of 80 to 100°C on the change in the tensile stress-strain curve, as well as the influence of carbon and manganese on the saturation and oversaturation effect. (8 fig.) (auth)

16404 ROLE OF SOME ALLOYING ELEMENTS ON RADIATION HARDENING IN PRESSURE VESSEL STEELS. Igata, N. (Tokyo Univ.); Watanabe, K.; Sato, S. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 63-74(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Recent trends in nuclear-pressure-vessel steels for light-water reactors have been toward Ni–Cr–Mo steels. The effect of minor elements—for example, Cu and P—also has been investigated. In this study, the role of Ni, Cr, Mo, and Cu was investigated to understand the irradiation behavior of pressure vessel steel, using internal friction measurement, transmission electron microscopy (TEM), and mechanical testing. The materials used were Fe–1Ni, Fe–0.25Cr, Fe–0.5Mo, and Fe–0.2Cu. They were annealed or quenched and irradiated from 1 to 3×10^{19} nvt(>1 MeV) at 60°C, and postirradiation annealing was performed in the range 150 to 450°C. The irradiation hardening was closely related to the amount of the solute nitrogen that corresponded to the amount of the complex defects in the aforementioned alloys. The irradiation hardening was primarily correlated with the strength of the interaction between solute nitrogen (or carbon) atoms. Other contributions of copper and molybdenum were considered. (5 fig) (auth)

16405 PROPERTY CHANGES RESULTING FROM IMPURITY-DEFECT INTERACTIONS IN IRON AND PRESSURE VESSEL STEEL ALLOYS. Smidt, F. A. Jr.; Sprague, J. A. (Naval Research Lab., Washington, DC). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 78-91(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The effects of 0.3 at. % Cu, V, Ni, and P and 0.1 at. % C addition on the irradiation response of pure Fe were investigated to clarify the role of Cu and P in embrittlement of pressure vessel steels. Compression tests and transmission electron microscopy (TEM) analysis of the aforementioned alloys and selected heats of pressure vessel steel and weldment were examined after irradiation to fluences of 2.5×10^{19} and 4.5×10^{20} n/cm^2 > 1 MeV at 290°C. Cu is found to influence the properties by promoting nucleation of defect aggregates, probably vacancy loops, at low fluences, thus increasing the radiation strengthening and shifting the transition temperature upward. Small voids were observed in the 0.3 Ni, 0.3 Cu, and 0.1 C alloys and in pure iron but not in 0.3 V or 0.3 P alloys. (28 references) (auth)

16406 DAMAGE-FUNCTION ANALYSIS OF NEUTRON-INDUCED EMBRITTLEMENT IN A302-B STEEL AT 550°F (288°C). Serpan, C. Z. Jr. (Naval Research Lab., Washington, DC). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 92-106(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

A damage function was derived for neutron-induced increases in the brittle to ductile transition temperature (ΔTT) of ASTM A302-B steel, for temperatures of 550 to 585°F. The damage function is a series of weighting factors for the damaging capacity of neutrons of all energy groups in a reactor spectrum that indicate the relative importance of specific energy-group neutrons to the damaging process. The damage function showed that the neutrons of energies greater than 1 MeV would account for about 75% of the ΔTT, but that neutrons of energies greater than 0.1 MeV would account for over 94% for virtually every spectrum evaluated. Furthermore, thermal neutrons were seen to contribute less than 5% of the ΔTT, and this only if the thermal population were an order of magnitude greater than the fast neutron population. A method was then developed for plotting neutron fluence (>0.1 MeV) weighted by the damage function that provides excellent correlation of the experimental 550 to 585°F irradiation data for diverse reactor environments. Adequate correlations of data can also be achieved (using only fluences > 0.1 MeV) if conditions preclude inclusion of the damage function. This is a totally rational approach for correlating experimental radiation damage results that has the advantage of being least susceptible to errors in flux spectrum and neutron dosimetry measurements. (auth)

16407 EFFECTS OF MICROSTRUCTURE ON SWELLING AND TENSILE PROPERTIES OF NEUTRON-IRRADIATED TYPES 316 AND 405 STAINLESS STEELS. Garr, K. R. (Rockwell International Corp., Canoga Park, CA); Rhodes, C. G.; Kramer, D. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 109-118(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Small-sheet tensile samples of Types 316 and 405 stainless steels were encapsulated together and irradiated in EBR-II at about 400°C to a total fluence of 3.3×10^{22} n/cm^2 with 2.3×10^{22} n/cm^2 fast (E > 0.1 MeV). A variety of microstructures was produced in each alloy prior to irradiation. In Type 316 stainless steel, swelling increased with the amount of carbide precipitation prior to irradiation, implying that carbon in solution impedes void formation. Cold-working 25% suppressed void formation. No swelling was observed in Type 405 stainless steel. Irradiation caused an increase in the yield and tensile strengths, and a decrease in ductility in all cases except the cold-worked Type 316 stainless steel. These latter samples showed a decrease in yield and tensile strengths and an increase in ductility due to the reversion of ϵ martensite to austenite. (6 tables) (auth)

16408 EFFECTS OF SECOND-PHASE PARTICLES ON IRRADIATION SWELLING OF AUSTENITIC ALLOYS. Appleby, W. K. (General Electric Co., Sunnyvale, CA); Wolff, U. E. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 122-136 (1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Results are described on swelling caused by fast-neutron-induced void formation in stainless steel fuel cladding and high-nickel alloys irradiated in fast flux (EBR-II) to fluences up to 7.3×10^{22} n/cm^2, E > 0.1 MeV. Immersion density measurements of swelling gave results ranging from a volume increase of 10% in solution-annealed Type 347 stainless steel to a small densification in Inconel-625. Transmission electron microscopy investigations revealed that the extent of void formation in Types 316 and 347 stainless steels, Incoloy-800, and Hastelloy-X was related to the degree of intragranular precipitation (principally carbides), whereas the Ni_3Cb precipitation in Inconel-625 had apparently inhibited void formation altogether. It is concluded that precipitate particles can play a major role in determining the extent of void formation in austenitic alloys during neutron irradiation, and in the optimum morphology (a high concentration of closely spaced, small and possibly coherent particles) they offer promise of largely inhibiting void formation and swelling. (6 fig) (auth)

16409 VOID FORMATION IN TYPE 1.4988 STABILIZED STAINLESS STEEL. Ehrlich, K.; Packan, N. H. (Kernforschungszentrum Karlsruhe, Ger.). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 137-148(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

A solution-treated 16Cr–13Ni niobium-stabilized stainless steel (Type 1.4988) was irradiated as fuel pin cladding in the DFR and Mol BR 2 reactors and also in the Harwell Variable Energy cyclotron (VEC) up to 4.0×10^{22} n/cm^2 (E > 0.1 MeV) or 3×10^{17} C^{2+} ions/cm^2. The irradiation temperatures ranged from 300 to 650°C. Postirradiation measurements included immersion density determinations, diametral change measurements, and transmission electron microscopy (TEM) observations. Void formation was observed in the temperature range 350 to 600°C. Swelling in Type 1.4988 was found to be lower than that reported previously for Types 304 and 316 unstabilized steel, especially at higher temperatures. Void concentration values at lower temperatures were comparable to those cited for 304 and 316 steels; however, they too decreased more strongly with increasing irra-

diation temperature. The stabilizing elements may have affected this behavior by a partial suppression of intragranular precipitates that were frequently associated with voids. (5 figs) (auth)

16410 SWELLING AND TENSILE PROPERTY EVALUATIONS OF HIGH-FLUENCE EBR-II THIMBLES. Fish, R. L.; Straalsund, J. L.; Hunter, C. W.; Holmes, J. J. (WADCO Corp., Richland, WA). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 149-164(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The effects of very high neutron fluences on tensile properties and swelling of 300-series austenitic stainless steel were evaluated by destructive examination of several EBR-II thimbles that had accumulated fluences approaching 1.2×10^{23} n/cm^2 ($E_n > 0.1$ MeV). Irradiation temperatures ranged from 370 to 470°C. Immersion density measurements on control or safety rod thimbles 3D1, 5C3, 5A3, and 3A1 indicate that swelling increases with neutron fluence. Maximum measured volume changes are about 11% at 1.1×10^{23} n/cm^2 ($E_n > 0.1$ MeV) and temperatures near 420°C. No indications of saturation were observed; in fact, swelling rates increase with increasing fluence over the whole range of fluences investigated. Anomalous swelling behavior was observed in control rod thimble 5A3. In this component, which may have been subjected to mechanical constraint, swelling gradients were found to be much lower than anticipated on the basis of the corresponding gradients in irradiation conditions. This behavior may be the result of an effect of stress on swelling not previously encountered. Tensile property changes are similar to those classically observed. When irradiation and test temperatures are equivalent, yield strength (0.2% offset) increases rapidly at low fluences and becomes fluence-independent at high fluence levels ($>7 \times 10^{22}$ n/cm^2, $E_n > 0.1$ MeV). Uniform elongation correspondingly decreases with increasing fluence and appears to saturate near 0.5% at higher fluence levels. This transition in fluence dependence of the properties is associated with a transition in fracture mechanism. The transition occurs from the usual homogeneous plastic dimpling fracture at low fluences to an extremely heterogeneous channel fracture at high fluence levels. (7 figs) (auth)

16411 NEUTRON IRRADIATION DAMAGE IN A PRECIPITATION-HARDENED ALUMINUM ALLOY. King, R. T.; Jostsons, A.; Farrell, K. (Oak Ridge National Lab., Oak Ridge, TN). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 165-180(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA '26 Jun 1972). See ASTM-STP-529, CONF-720604-.

A 6061 aluminum alloy target sleeve from the high flux isotope reactor, originally in a precipitation-hardened condition, was examined for neutron radiation damage after exposure to a maximum fast fluence of 9.2×10^{22} n/cm^2 ($E > 0.1$ MeV) and a thermal fluence of 1.38×10^{23} n/cm^2 at 60°C. Voids and a transmutation-produced silicon precipitate were found to cause about 1.1% internal swelling; a surface oxide scale contributed additional swelling. Irradiation-induced strength increases were measured at test temperatures in the range 25 to 200°C and are accounted for in terms of the observed silicon precipitate and an associated dislocation structure. There was also a loss of ductility that was most severe at 200°C. The fracture mode appeared to remain transgranular over the range of test temperatures. (auth)

16412 COMPARISON OF THE HIGH-TEMPERATURE DAMAGE STRUCTURES IN ACCELERATOR AND REACTOR IRRADIATED MOLYBDENUM. Eyre, B. L.; Evans, J. H. (United Kingdom Energy Authority, Harwell, Eng.). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 184-198(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The damage structures produced in high-purity Mo by neutrons in a fast reactor and by 2-MeV nitrogen ions in an accelerator were compared using transmission electron microscopy (TEM). The irradiations were carried out in the temperature range 450 to 900°C and doses in the range 10 displacements per atom (dpa) to 200 dpa. Over these ranges the damage structures can be defined in terms of a dislocation component and a void component. Several features of the void structures are found to be independent of the method of damage production, although the dose rate differences affect the temperature range and lower threshold dose for the formation of visible voids. With regard to the dislocation component of the structures, there is a qualitative similarity in distribution of loops and network dislocations between the reactor- and accelerator-irradiated specimens. However, a detailed analysis of the nature of the loops reveals important differences. The loops in reactor-irradiated specimens are predominantly interstitial in nature whereas the loops in accelerator-irradiated specimens containing voids are predominantly vacancy in nature. This result is discussed in detail together with other aspects of the comparative study. (6 figs) (auth)

16413 SWELLING MECHANISM IN THE IRRADIATED BORON-CONTAINING STAINLESS STEEL. Altovskii, I. V.; Elesin, L. A.; Platonov, P. A.; Savel'ev, E. G. (Inst. of Atomic Energy, Moscow). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 199-209(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The dilatometric investigation of the swelling of irradiated boron stainless steel was carried out at a constant temperature and constant heating rate. A quantitative swelling model is proposed based on the mechanism of the capture of migrating equilibrium vacancies by immobile bubbles. The differential equation describing the process of establishing gas bubble equilibrium with time has been derived. The application of this equation made it possible to describe quantitatively all the stages of the material thermal annealing and determine the physical parameters characterizing the processes occurring in the material swelling. (6 figs) (auth)

16414 VOID SWELLING BEHAVIOR OF TYPES 304 AND 316 STAINLESS STEEL IRRADIATED WITH 4-MeV Ni^+ IONS. McDonald, S. G. (Westinghouse Electric Corp., Pittsburgh, PA); Taylor, A. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 228-240(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

A study was made of the void and dislocation microstructure of Types 304 and 316 stainless steel irradiated with 4-MeV $^{58}Ni^+$ at a displacement rate of 5×10^{-3} dpa·s^{-1}. The range of dosages investigated were 20 to 350 dpa at 525°C and 20 to 250 dpa of 600°C for Type 304 stainless steel and 20 to 250 dpa at 525°C for Type 316. The maximum swelling data for Type 304 stainless steel may be represented by a power-law dependence on dosage with exponents of 1.4 and 1.8 at 525 and 600°C, respectively. The swelling at 600°C, which is much greater than that at 525°C, is due to the more rapid growth of voids at the higher temperature. No evidence of a reduction in swelling rate at high dosages was found at either temperature. The swelling of Type 316 stainless steel shows a tendency to be lower than that of Type 304 and, at higher dosages, is a factor of two less. In 20% cold-worked Type 316 stainless steel, swelling was suppressed until the dislocation structure was recovered. (8 figs) (auth)

16415 VOID FORMATION IN PROTON-IRRADIATED TYPE 316 AND TITANIUM-MODIFIED 316 STAINLESS STEELS. Keefer, D. W.; Pard, A. G.; Kramer, D. (Rockwell International Corp., Canoga Park, CA). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 244-257(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Void formation was studied in annealed Type 316 stainless steel irradiated with 1-MeV protons at 400, 500, and 600°C for amounts of damage up to 50 displacements per atom (dpa). Prior to irradiation, the samples were injected with about 5 atomic ppM helium to simulate the fast-reactor situation, where helium is generated by (n,α) reactions. The volume increase at each temperature, as determined by quantitative electron microscopy, varied exponentially with displacement damage and the exponent increased with temperature. Volume increases exceeding 20% were associated with 50 dpa at 500°C and 20 dpa at 600°C; no limits on volume increases were apparent at any temperature. Void number density decreased and average void size increased with increasing temperature for a constant damage. A titanium-modified 316 stainless steel developed a very inhomogeneous void distribution when proton irradiated at 600°C. However, the addition of Ti did not appear to diminish the volume increase at damages between 5 and 10 dpa, when compared with ordinary Type 316 stainless steel. (7 figs) (auth)

16416 ATTRITION AND STABILIZATION OF VOID NUCLEI: CRITICAL NUCLEUS SIZE. Beeler, J. R. Jr.; Beeler, M. F. (North Carolina State Univ., Raleigh). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 289-302(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Computer experiments were performed on the effect of impurity atoms, hydrostatic pressure, uniaxial tension, and radiation attrition on void nucleus stability in alpha-iron. The critical void nucleus size was found to be a 44-vacancy octahedral (bipyra-

midal) void with (110) facets. Helium atoms, oversize metallic impurity atoms, and carbon–vacancy complexes served as strong centers for heterogeneous nucleation of voids. Carbon–vacancy complexes at void apexes and corners inhibited thermal dissociation. The amount and tenacity of vacancy trapping by carbon atoms increased with hydrostatic pressure up to 110 kilobars. (6 figs) (auth)

16417 PRODUCTION OF VOIDS IN STAINLESS STEEL BY HIGH-VOLTAGE ELECTRONS. Garner, F. A. (Westinghouse Advanced Reactors Division, Madison, PA); Thomas, L. E. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 303-323(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Neutron-induced void formation in 300 series stainless steels was simulated by 1000-keV electron bombardment of thin foils in a high-voltage microscope. Stereomicroscopy was used to determine the effect of surface proximity and to establish mimimum foil thickness criteria for irradiations that would yield results characteristic of bulk material. Irradiation of specimens which are too thin yields misleading results, including an apparent saturation of swelling which actually is an artifact of the surface influence. Bulk-characteristic irradiations lead to volume increase as large as 100% without saturation. Void nucleation in these irradiations was very sensitive to the initial microstructure. The thickness of zones denuded of voids at specimen surfaces was found to be very sensitive to temperature and surface conditions, particularly oxidation. The denuded zone width appears to be controlled by the effective vacancy migration behavior. (auth)

16418 VOID FORMATION IN SOME NICKEL–ALUMINUM ALLOYS DURING 20-MeV C^{++} AND 46.5 MeV Ni^{6+} IRRADIATION. Hudson, J. A.; Francis, S.; Mazey, D. J.; Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 326-333(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The damage intensity along the ions track during 46.5-MeV Ni^{6+} irradiations of nickel and nickel-based alloys at void formation temperatures was calibrated. Swelling versus depth profiles were determined in several nickel foils bombarded to a range of doses with 46.5 MeV Ni^{6+} at 525°C. Comparison with previous data on swelling in nickel after 20-MeV C^{2+} irradiation at this temperature was made to calibrate the Ni^{6+} irradiations. Void formation in three nickel–aluminum alloys, at 525°C (977°F), to doses up to 60 dpa has been studied. The alloys contained 6, 8.5, and 13.5 at. % Al respectively and all specimens also contained [10^{-3}] injected helium. They were bombarded with 20-MeV C^{2+} and 46.5-MeV Ni^{6+}. The "incubation" dose for void formation, compared with that for pure nickel, was increased. The void concentration decreased with increasing aluminum content in solution and the presence of Ni_3Al (γ') precipitates in the third alloy had little effect on the swelling characteristics. The observations were interpreted in terms of an interaction between the Al in solution and the injected helium which starves many potential void nuclei of gas. (5 figs) (auth)

16419 MATERIALS PERFORMANCE PREDICTION FROM IRRADIATION TEST DATA. Yoshikawa, H. H. (Westinghouse Hanford Co., Richland, WA). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 337-348(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

A method is described for determining irradiation effectiveness of different neutron spectra in causing radiation damage to fuel cladding and reactor structural materials. It involves the definition of a semi-empirical damage function or cross section using measured data from specimens irradiated in thermal and fast test reactor spectra. The damage function is applied to design problems involving irradiation effects to reactor structural and fuel cladding materials to predict the fluence that would produce a specific damage level. (7 figures) (auth)

16420 HIGH-TEMPERATURE EMBRITTLEMENT OF FERRITIC AND AUSTENITIC STAINLESS STEELS IRRADIATED UP TO 1.6×10^{22} n/cm^2 (> 0.1 MeV). Van Asbroeck, Ph.; Snykers, M.; Vandermeulen, W. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 349-359(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Tension specimens of four basic stainless steels having a bcc or fcc structure without or with nickel addition were fabricated by casting and by powder metallurgy (without and with TiO_2 addition). These specimens were irradiated at 60°C up to a 1.6×10^{22} n/cm^2 fast fluence (>0.1 MeV) and ruptured at 700°C. A structural and statistical analysis shows that bcc structure, powder metallurgy fabrication methods, TiO_2 additions, and transgranular rupture enhance the 700°C resistance to fast neutron embrittlement. The degree of embrittlement is related to the rupture mode before irradiation. (auth)

16421 DUCTILITY OF IRRADIATED TYPE 316 STAINLESS STEEL. Holmes, J. J.; Lovell, A. J.; Fish, R. L. (WADCO, Richland, WA). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 383-398(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The effect of fast reactor irradiation on the ductility of annealed AISI Type 316 stainless steel is described in terms of strain rate, temperature, and neutron fluence. Creep and tensile data obtained after EBR-II irradiations are presented and analyzed in terms of controlling deformation mechanisms. The basic nature of each deformation process is used to infer ductility loss trends and to define the environmental conditions where specific ductility-fluence relationships apply. The resulting correlation quantitatively describes ductility to fluences approaching 7×10^{22} n/cm^2, strain rates from 10^{-6} to 10^4/h, and temperatures from 370 to 760°C. (3 tables, 8 figures) (auth)

16422 EFFECTS OF FAST-NEUTRON IRRADIATION ON TENSILE PROPERTIES AND SWELLING BEHAVIOR OF VANADIUM ALLOYS. Carlander, R.; Harkness, S. D.; Santhanam, A. T. (Argonne National Lab., IL). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 399-414(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Fast-neutron-induced void formation in commercial pure vanadium is dramatically reduced by additions of titanium and/or chromium. As little as 1 wt % Ti decreases the void number density and void volume fraction by factors of 30 and 100, respectively, compared with pure vanadium after exposure at 525°C to a fluence of 1.1×10^{22} n/cm^2, $E_n > 0.1$ MeV. Additions of 3 wt % Ti or greater suppress void formation entirely under the same exposure conditions. Alloys of 10 and 15 wt % Cr were also found beneficial in limiting swelling. Internal-friction measurements show that the reduction in void formation in the V–Ti alloys may be partly related to the removal of interstitial impurities, oxygen, and nitrogen by the titanium to form a coherent precipitate of Ti_2O_3 or a complex oxynitride. Excess oxygen in the alloy after consumption of the available titanium as a precipitate results in increased void formation and also loss of precipitate coherency. The tensile properties of V–20Ti alloy are only slightly affected by in-reactor exposures as high as 5.4×10^{22} n/cm^2, $E_n > 0.1$ MeV. Initial hardening is observed at low fluences and irradiation temperatures that are probably due to point-defect clusters or precipitates nucleating on interstitial impurities. However, the hardening effect saturates after low neutron exposures and is found to be independent of both fluence and temperature. Specimens of V–20Ti irradiated at ~600°C to the highest fluence of $\sim 6 \times 10^{22}$ n/cm^2, $E_n > 0.1$ MeV showed a few voids and a dislocation network. However, under these conditions, swelling is negligible and is not sufficiently severe to cause any noticeable effect on the tensile properties. (12 figures) (auth)

16423 BURST TESTING OF ZIRCALOY CLADDING FROM IRRADIATED PICKERING-TYPE FUEL BUNDLES. Hardy, D. G. (Atomic Energy of Canada Ltd., Chalk River, Ontario). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 415-434(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Closed-end burst tests were conducted on sections of fuel cladding cut from five Pickering-type fuel bundles after exposures of 2.5 to 4.8×10^{24} n/m^2 (>1 MeV) at 300°C. Five batches or heat treatments of Zircaloy-2 and -4 were tested at 22 and 300°C. Two of the bundles contained an unfueled element in the center ring. The burst test results obtained from fueled and unfueled sheaths are compared with the same cladding batches irradiated to similar fluences without fuel in a fast neutron facility at 125 to 250°C and to unirradiated controls. The fueled cladding specimens exhibited higher strength and lower total circumferential elongation than unfueled specimens irradiated in the fast neutron facility. Although the fueled cladding was strained as much as 1.2% by thermal expansion of the UO_2, the uniform elongation in subsequent burst tests was often higher than that obtained on bursting tubing irradiated in the fast neu-

tron facility. Most of these differences were attributed to the different irradiation temperatures that produced a variation in the size distribution of radiation damage and perhaps a variation in the stability of the defect loops under strain. While there was no visual or metallographic evidence of interaction between the fuel and the cladding, there was a slight difference in properties between the fueled cladding and unfueled sheaths contained in the same fuel bundles. The slightly lower strength and total circumferential elongation of the fueled cladding were taken as evidence of some mechanical interaction, probably the 0.1 to 1.2% plastic strain imposed on the sheath by the thermal expansion of the UO_2. There were indications of a texture effect in irradiation hardening with the greater values occurring in instances where deformation took place almost entirely by slip. Hydrogen concentrations in the range 170 to 719 ppM drastically reduced the 22°C strength and ductility, but the 300°C properties were significantly reduced only in cladding with a low level of cold work. (8 figures) (auth)

16424 INFLUENCE OF NEUTRON SPECTRUM AND MICROSTRUCTURE ON THE POSTIRRADIATION CREEP-RUPTURE BEHAVIOR OF AN AUSTENITIC Cr–Ni–Ti–B STEEL. Boehm, H.; Wassilew, C. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 437–450(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The influence of neutron irradiation on the postirradiation creep rupture properties of a 15Cr–15Ni–Ti–B steel and their dependence on microstructure and neutron spectra were studied. The steel was tested in three conditions: (a) solution treated at 1150°C, (b) solution treated and aged at 1025°C, (c) solution treated and aged at 900°C. The conditions are characterized by an increasing amount of TiC precipitates going from treatment (a) to (c). The irradiations were carried out in the BR-2 reactor (Mol/Belgium) to a fast neutron fluence of 2×10^{21} n/cm^2 (E > 0.1 MeV) and in the FR-2 reactor (Karlsruhe) to a thermal neutron fluence of 3×10^{20} n/cm^2. The ratio of thermal to fast neutron flux was about 0.66 for BR-2 and 30 for FR-2 irradiations. The irradiation temperature was about 70°C. The postirradiation creep rupture tests were carried out at 650°C. The changes in creep rupture properties after irradiation were found to be strongly dependent on the neutron spectrum and the thermal pretreatment of the steel. 1. The fast thermal neutron irradiation in the BR-2 caused an increase in rupture life and decrease in creep rate of the steel in the solution-treated condition and also, but to a lower extent, in the 1025°C aged condition. With increasing stress the difference between the irradiated and unirradiated values diminished. 2. Irradiation in the FR-2 caused a decrease in rupture life and increase in creep rate of the 1150 and 1025°C annealed conditions. The effect was more pronounced in the solution-treated than in the 1025°C annealed condition. The difference between the irradiated and unirradiated values decreased with decreasing stress. 3. There were no remarkable changes in creep rate and rupture life after irradiation of the steel in the 900°C annealed condition. Results are discussed in terms of radiation-influenced precipitation processes superimposed by radiation-induced high-temperature embrittlement. (auth)

16425 FATIGUE BEHAVIOR OF IRRADIATED THIN-SECTION TYPE 348 STAINLESS STEEL AT 550 F (288 C). Smith, H. H.; Shahinian, P. (Naval Research Lab., Washington, DC). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 451–459 (1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Fatigue life and crack growth rate comparisons were made of irradiated and unirradiated specimens of Type 348 stainless steel as a function of total strain amplitude. Notched specimens were cycled at resonance in reverse bending in dry air at constant amplitude, and crack growth rates were determined from changes in resonant frequency of vibration. Neutron irradiation to a fluence of 1.5×10^{21} n/cm^2 > 0.1 MeV produces approximately an order of magnitude increase in fatigue life at a total strain of 0.20%. At lower strains, irradiated fatigue life appears to approach an endurance limit and the increase in life becomes very large. The effects on life are attributed to decreased crack growth rates in the irradiated material. Thus, the results in dry air indicate that the fatigue performance at 550°F of thin-section reactor components of Type 348 stainless steel should not be reduced by irradiation characteristic of pressurized water reactors. The influence of water vapor on the fatigue characteristics of irradiated Type 348 stainless steel is being investigated in a separate study. (7 figures) (auth)

16426 IN-PILE STRESS RUPTURE STRENGTH OF THREE STABILIZED AUSTENITIC STAINLESS STEELS. Closs, K. D.; Schaefer, L. (Kernforschungszentrum Karlsruhe, Ger.). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 460–472(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The in-pile stress rupture strength of three different types of stabilized austenitic stainless steels was studied: a 16Cr–13Ni–Nb steel (20 and 5% cold worked), a 16Cr–16Ni–Nb steel (5% cold worked), and a 15Cr–15Ni–Ti–B steel (15% cold worked). Irradiation time was up to 4800 h, corresponding to a maximum fast neutron fluence (E > 0.1 MeV) of 8.2×10^{21} neutrons n/cm^2. The specimens were irradiated at 615 and 720°C. Neutron irradiation caused a marked decrease in time to rupture and rupture strain in all the materials tested. The 15Cr–15Ni–Ti–B steel showed the most severe reduction in time to rupture. This reduction was attributed to high-temperature embrittlement and an increase in creep rate. It was shown that the precipitation behavior of this material was changed by neutron irradiation. The reduction in time to rupture was lower for the 16Cr–13Ni–Nb and 16Cr–16Ni–Nb steels. No enhancement in creep rate could be detected. The rupture strains measured were higher than 1% for the two Nb stabilized steels, whereas they were below 1% for the 15Cr–15Ni–Ti–B steel. (8 figures) (auth)

16427 INFLUENCE OF IRRADIATION ON THE CREEP/FATIGUE BEHAVIOR OF SEVERAL AUSTENITIC STAINLESS STEELS AND INCOLOY 800 AT 700 C. Brinkman, C. R. (Aerojet Nuclear Co., Idaho Falls, ID); Korth, G. E.; Beeston, J. M. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 473–492 (1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Results from elevated temperature-strain controlled fatigue and constant-strain-rate tensile tests conducted on specimens of stainless steel Types 304, 304L (titanium modified), 316, as well as Incoloy 800 are reported. Specimens were irradiated to fluences of 0.4 to 5×10^{22} n/cm^2, E > 0.1 MeV at 700 to 750°C, while the postirradiation test temperature was maintained at 700°C. Reductions in tensile ductility and fatigue life occurred, with reductions in fatigue life ranging from factors of approximately 1.5 to 2.5 for the stainless steels and up to 35 for Incoloy 800 in comparison with the thermal controls. Comparisons are made between actual irradiated fatigue behavior and predictions based on several semi-empirical methods using irradiated tensile data. These methods generally provided good estimates of the irradiated fatigue behavior of these materials. Introducing tensile hold times into the fatigue cycles of irradiated and unirradiated Type 316 stainless steel resulted in substantial reductions in the fatigue life of this material. However, for tensile hold times in excess of 0.1 h, a tendency towards saturation of the hold-time effect was found in both the irradiated and unirradiated material. Creep and fatigue damage for Type 316 stainless was determined and summed linearly. This total damage was found to be a function of strain range, duration of tensile hold time, and irradiation condition for Type 316 stainless steel. (7 tables, 6 figures) (auth)

16428 EFFECT OF NEUTRON IRRADIATION ON FATIGUE CRACK PROPAGATION IN TYPES 304 AND 316 STAINLESS STEELS AT HIGH TEMPERATURES. Shahinian, P.; Watson, H. E.; Smith, H. H. (Naval Research Lab., Washington, DC). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 493–508 (1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

Resistance to fatigue crack propagation of pre- and postirradiation AISI Types 304 and 316 stainless steels was determined at 800 and 1100°F using the fracture mechanics approach. The effect of irradiation on fatigue resistance was dependent upon test temperature and irradiation conditions. In general, irradiation degraded fatigue resistance at 1100°F, but at 800°F enhancement as well was observed. In both steels irradiated in a thermal reactor to a fluence of 1.8×10^{21} n/cm^2 > 0.1 MeV, fatigue crack growth rates at 800°F were lower than in the unirradiated steels for a given stress intensity factor range (ΔK). However, at 1100°F the effect was reversed and crack growth rates were higher in the irradiated steels. Irradiation in a fast reactor to a fluence of ~1.2×10^{22} n/cm^2 > 0.1 MeV caused fatigue crack growth rates at 800°F to increase at low values of ΔK and decrease at high values of ΔK. At 1100°F, the crack growth rates in the irradiated steel were either the same as or higher than in the unirradiated steel. The influence of irradiation on fatigue life generally re-

flected the effect observed on crack growth rate. (9 figures, 23 references) (auth)

16429 EFFECTS OF IRRADIATION ON THE TENSILE AND STRUCTURAL PROPERTIES OF FV548 STAINLESS STEEL. Watkin, J. S. (United Kingdom Atomic Energy Authority, Springfields, Eng.); Shepherd, J. P.; Standring, J. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 509-528(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The tensile properties of the Nb-stabilized austenitic steel FV548 were investigated after irradiation in a thermal reactor up to fluences of 4×10^{20} n/cm^2 (thermal) and in a fast reactor up to fluences of 2.7×10^{22} n/cm^2 (total). The parameters studied include the effects of irradiation temperature, covering the temperature range 550 to 750°C; the effects of solute level produced by increasing the solution heat-treatment temperature from 950 to 1300°C; and the effects of pre- and postirradiation aging. Testing was carried out over the strain-rate range 5×10^{-4} to 5×10^{-6} per second and at temperatures between 550 and 750°C. The microstructures obtained during irradiation were also investigated and the results correlated with the tensile properties. Suggested mechanisms for the effects observed are discussed. (9 figures, 7 tables) (auth)

16430 EFFECT OF NEUTRON IRRADIATION ON VANADIUM. McIlwain, J. F. (Ames Lab., IA); Chen, C. W.; Bajaj, R.; Wechsler, M. S. Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 529-540(1973).

From symposium on effects of radiation on substructure and mechanical properties of metals and alloys; Los Angeles, California, USA (26 Jun 1972). See ASTM-STP-529; CONF-720604-.

The effect of neutron irradiation on vanadium containing 50 to 800 weight ppM oxygen was studied using electrical resistivity, internal friction, and mechanical property measurements. The resistivity and internal friction specimens were irradiated to 3×10^{18} neutrons/cm^2 (E > 1 MeV) at –190°C and the tension test specimens were irradiated to 1.2×10^{19} neutrons/cm^2 (E > 1 MeV) at 106°C. Postirradiation annealing treatments were performed up to 220°C for the resistivity and internal friction specimens and up to 520°C for the tension test specimens. Isochronal resistivity annealing measurements exhibited annealing stages at 170, 30, and –105°C. The highest temperature stage (near 0.2 T_m, where T_m is the melting temperature) is attributed to the motion of interstitial oxygen to radiation-produced defect clusters and loops, where the oxygen is effectively removed from solid solution. This conclusion is based on the observations that: (a) the annealing activation energy is 1.1 ± 0.1 eV, close to the oxygen migration energy of 1.23 eV; (b) the magnitude of the annealing stage increased with increasing oxygen concentration; and (c) the decreases in oxygen concentration in solid solution upon annealing deduced from the decrease in resistivity and the decrease in the oxygen internal friction peak are in substantial agreement. The origins of the two lower temperature peaks are unknown, although it is speculated that hydrogen may be involved in the peak at –105°C. The yield stress measurements indicate that radiation exposure at 106°C results in greater radiation hardening for specimens with larger oxygen concentration. Also, the further increase in strength upon postirradiation annealing (radiation-anneal hardening) is enhanced by increasing interstitial impurity concentrations. (auth)

16431 RECOVERY OF IRRADIATED Fe–0.52%Mo–C ALLOYS. Takahashi, J.; Yamane, T.; Mima, G. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 11, 704-706(Nov 1973).

Two Fe–0.52%Mo–C(0.035 and 0.024%) alloys were irradiated in JMTR to a dose of 10^{20} nvt (>1 MeV) at 70–75°C. Changes in the internal-friction Snoek peaks on irradiation and annealing were followed; torque vs shear strain and yield shear stress vs annealing temperature were also measured. Results are explained by a model in which the recovery of radiation hardening is due to decomposition of C–vacancy complexes or Mo–C–V complexes. (DLC)

16432 EFFECTS OF RADIATION ON SUBSTRUCTURE AND MECHANICAL PROPERTIES OF METALS AND ALLOYS. Seventy-fifth Annual Meeting of the American Society for Testing and Materials, Los Angeles, California, June 25–30, 1972. ASTM Special Technical Publication 529. Philadelphia; American Society for Testing and Materials (1973). 552p. (ASTM-STP-529; CONF-720604-). $49.50.

Thirty-five papers are presented in 6 sections dealing with fracture behavior and structure/impurity effects in reactor vessel steels; neutron-induced voids and phases; charged-particle-induced voids and computer experiments; ductility; and creep, fatigue, and tensile properties. Separate abstracts were prepared for 28 of the papers; 5 of the remaining papers were previously abstracted as NSA 27: 22980, 27: 23776, 28: 11332, 30: 4014, and 30: 7414. (DLC)

For abstracts of individual papers see: 16403–16430.

16433 POSITRON-ANNIHILATION STUDIES OF VOIDS IN NEUTRON-IRRADIATED ALUMINUM SINGLE CRYSTALS. Triftshaeuser, W.; McGervey, J. D.; Hendricks, R. W. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev., B; 9: No. 8, 3321-3324(15 Apr 1974).

The angular correlation of positron-annihilation radiation from single crystals of aluminum in which voids had been induced by neutron irradiation was measured. The angular-correlation curve is narrower than that for aluminum containing vacancies. The data fit well a curve computed on the assumption that the positrons are annihilated at the void surfaces. After the sample was heated to 325°C the angular-correlation curve became identical to that of normal Al. (auth)

16434 CHANGE IN THE STRUCTURE OF GERMANIUM AND SILICON DURING ION BOMBARDMENT AND SUBSEQUENT ANNEALING. Pavlov, P. V. (Gorky Scientific-Research Physical-Technical Inst., USSR). Sov. Phys.-Cryst. (Engl. Transl.); 18: No. 4, 506-509(1973).

Translated from Kristallografiya; 18: No. 4, 807-812(1973).

An electron-diffraction study of the short-range structure of amorphous Ge films obtained by bombardment with N^+, Ar^+, and Xe^+ was made. The structure consists of pentagonal rings. Amorphous Si has the same structure. The present article discusses possible amorphization mechanisms during bombardment, preference being given to the mechanism involving amorphization through accumulation of radiation induced point defects. It was shown that vaporization of the surface atoms can cause amorphization of the surface layer. Experiments on the diffusion of ^{114}In and ^{71}Ge in Si previously subjected to bombardment with a dose of 6×10^{15} ions/cm^2 of Ar^+ ions established that complete annealing of defects during crystallization of the amorphous layer does not occur even at a temperature of 1000°C. (26 references) (auth)

16435 ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS EMITTED FROM COPPER SINGLE CRYSTALS BOMBARDED BY IONS. Mischler, J.; Colombie, N. (Univ. Paul Sabatier, Toulouse). Surface Sci.; 40: No. 2, 311-319(Nov 1973). (In French).

Energy angular distributions of the secondary electronic emission from copper single crystals bombarded by 40 keV Ar^+ ions are studied. These distributions, recorded as a function of the reception azimuth angle, with fixed polar angle, show an anisotropy which is both characteristic of the target crystalline structure and of the collected electron energy. These results are interpreted in terms of bulk electron diffraction. (auth)

16436 EFFECT OF DEUTERON IRRADIATION ON THE MAGNETIC ANISOTROPY OF THIN Ni–Fe FILMS. Kuwahara, K. (Hiroshima Univ.); Kobayashi, M.; Yamamoto, S. Jap. J. Appl. Phys.; 12: No. 10, 1567-1571(Oct 1973).

Thin films of Ni–Fe (Ni 50–100%) are irradiated by 250-kV deuterons below 50°C. The anisotropy constant, K_u, of normal incidence films reaches a saturation value with 10–20 minutes irradiation (10^{16} deuterons/cm^2), easy axis being parallel to the magnetic field applied during irradiation. The saturation value of K_u as a function of Ni concentration is explained well by the atom and vacancy orders. The change in K_u of oblique incidence films is independent of the field direction during irradiation. In the case of 30° incidence, K_u increases (Ni < 85%) or decreases (Ni > 90%) at the initial stage of irradiation, and after the initial change $|K_u|$ decreases monotonously. In the case of 60° incidence, a similar result is obtained except that the initial stage change in K_u with irradiation is not so clear. Results are suspected to be due to a change in the columnar structure caused by the vacancy migration. (auth)

16437 CLADDING AND STRUCTURAL MATERIALS FOR FUEL COMPONENTS AND ASSEMBLIES. Mosedale, D. (United Kingdom Atomic Energy Authority, Dounreay, Eng.); Barnaby, J. W.; Bramman, J. I.; Bell, D. I.; Harris, D. R. pp 131-144 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The required properties of materials for fuel components and assemblies are outlined in the context of design concepts for LMFBR cores. Attention is focused on those requirements which have been recognized from the examination of components and materials samples irradiated in the Dounreay Fast Reactor and particularly on mechanical property aspects with the void swelling phenomenon in mind. Void swelling results from the examination of materials irradiated in DFR are presented and

the dependence of the extent and nature of the phenomenon on material and environmental variables is discussed. Investigational techniques used include immersion density and high-precision dimensional measurements and thin-film electron microscopy. Results from charged-particle irradiations—these provide large accelerations of void growth rates—are outlined and findings are related to the reactor situation. Irradiation creep, offering one design solution to the problems arising from differential swelling in gradients of neutron flux, is also of importance in fuel cladding behavior, particularly in the high-flux, intermediate-temperature region of fuel pins. Findings from irradiations of loaded helices are summarized and related to core performance. Mechanical property measurements, in the main high-temperature tensile tests, have been made on a variety of irradiated materials. Results are given and assessed. Finally, the fabrication of materials selected for core use is discussed. (auth)

16438 CREEP RUPTURE BEHAVIOR OF A NEUTRON-IRRADIATED 15/15 CrNiTiB STEEL UNDER CONSTANT AND INCREASING LOAD. Boehm, H.; Wassilew, C. (Kernforschungszentrum, Karlsruhe, Ger.). pp 169-178 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The effects of neutron irradiation (irradiation temperature ≈650°C, $\phi t = 0.94 \times 10^{22}$ n/cm² (E > 0.1 MeV)) on the creep rupture properties at 700°C of a 15/15 CrNiTiB steel (10% cold-worked + aged at 850°C) tested under both constant and increasing load are described. The stress was increased in steps of 1 kg/mm with a "mean stress increase rate" between 10^{-1} and 5×10^{-3} kg/mm²/h. For creep rupture properties under constant load, the neutron irradiation causes a strong decrease in rupture life and ductility but only small changes in the secondary creep rate. The results of the creep rupture tests of irradiated specimens under increasing load indicate that the rupture time obeys the life fraction rule: $\Sigma_{i=1}^{n}(\Delta t_i/t_{R_i} = 1)$. ($\Delta t_i$ = time spent at stress σ_i; t_{R_i} = rupture time of irradiated specimens at stress σ_i; n = number of stress steps) very well, though it is known that this description of cumulative damage is normally only a rough approximation. The experimental results for creep show that the specimens tested under increasing load creep much faster than calculated, if the calculation is based on the measured secondary creep rates of irradiated specimens under constant load. There seems to be no marked effect of the type of testing (constant or increasing load) on the creep ductility. The results are discussed in detail. (auth)

16439 TEMPERATURE DEPENDENCY OF VOID FORMATION IN DIFFERENT STABILIZED STAINLESS STEELS. Ehrlich, K.; Gross, R. (Kernforschungszentrum, Karlsruhe, Ger.). pp 179-197 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The temperature dependence of void formation was studied in three different stabilized stainless steels: a 16Cr–12Ni niobium stabilized material (type 1.4988), a 16Cr–16Ni niobium stabilized steel (type 1.4981) and a 15Cr–15Ni titanium stabilized material (type 1.4970). The effects of different thermomechanical pretreatments were investigated. The materials were irradiated by 20 MeV C^{2+} ions at the Variable Energy Cyclotron in a temperature range of 500 to 650°C. A uniform damage level of 40 displacements per atom (corresponding to a neutron dose of 8 to 9×10^{22} n/cm² DFR equivalent) was achieved in the region between 5 and 7 μm deep. A pre-implantation of 10 atomic ppM helium was given to simulate the helium generation which takes place at reactor irradiations. All materials show void formation in the above-mentioned temperature region. In all cases the maximum volume increase was observed at 575°C and ranges from 1% to 4% depending on the amount of cold work. The mean void diameters increase with irradiation temperature. Higher degrees of cold work lead to smaller mean void sizes. Void concentrations decrease with increasing irradiation temperature. Higher degrees of cold work lead to an inhomogeneous spatial distribution of voids. At 500°C the voids generally appear to be spherical. At 575°C the voids are octahedra with truncated corners. At the highest irradiation temperature the voids are very often bounded by {210} planes. A comparison of the results with similar experiments on type 316 stainless steel shows a reduced volume increase of the stabilized materials at the high irradiation temperatures. The results are discussed in terms of the degree of cold work and alloy composition. (auth)

16440 EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF WELDED AUSTENITIC STAINLESS STEEL. Solano, R. R. (Junta de Energia Nuclear, Madrid); Hes, G. pp 227-252 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In Spanish)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

The mechanical properties of welded specimens of a 16/13 CrNi + Nb steel were determined before and after exposure to an integrated neutron flux of 3×10^{22} n/cm². Unwelded specimens of the same steel were used as controls. In order to determine the behavior of the welded zone, specimens were prepared by exposure to a high-temperature thermal cycle similar to that involved in the welding operation itself. The effect of irradiation was found to be less pronounced in the welded zone than in the unwelded material. (auth)

16441 DEFORMATION OF FUEL SUB-ASSEMBLY HEXAGONAL WRAPPERS DUE TO STAINLESS STEEL SWELLING. Balloffet, Y.; Ginier, R. (CEN, Cadarache, France). pp 277-289 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

Deformations of sub-assembly structural components (the hexagonal wrapper in particular) due to stainless steel swelling give rise to a problem, especially in large breeder reactors where the neutron flux is much larger than in smaller reactors. The use of swelling equations for Phénix derived from Rapsodie sub-assembly test data shows that large deformations of the fuel sub-assemblies occur, resulting in displacements of the upper ends and interactions between the sub-assemblies of the core. These deformations and the stresses arising in the components were estimated as functions of burnup, when the existing gaps do not allow a free deformation of the sub-assembly. (auth)

16442 COMPUTER PROGRAM FOR THE STRESS-STRAIN ANALYSIS OF A WRAPPER TUBE IN A FAST REACTOR ENVIRONMENT. Guyette, M.; Capart, G. (Belgonuclear, Brussels). pp 291-307 of Fuel and Fuel Elements for Fast Reactors. Vol. II. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.2); CONF-730726-P2.

Hexagonal wrapper tubes are submitted to very severe conditions during irradiation life in fast reactors. A computer program STRAW has been developed to predict stress and strain distributions within such a wrapper tube and its evolution (including creep effects) as irradiation proceeds. The stresses are assumed to derive from three main causes: compatibility of strains, pressure differences, and boundary conditions. The program is used to calculate stresses and strains at discrete values of time at many locations axially and circumferentially along the tube. Choice of time intervals is left to the user but the program can automatically divide the time intervals into subintervals to preserve the accuracy of the creep strains. This subdivision depends largely on the stress level reached and on its corresponding creep rate. Any number of intermediate supports may be selected, each support being elastic with the possibility of specifying initial displacements in translation and in rotation. Simulation of tube rotation at various stages of its in-pile life with subsequent alteration of swelling behavior is also possible as well as calculation of residual deformation in cold state. Flux and temperature distributions are fully three dimensional. Any flux and temperature field arising in a fast reactor can therefore be accurately simulated by the program. Thermal, swelling and creep strains (irradiation induced, as well as thermal creep) are thus also taken into account with their three-dimensional pattern. The number of input data has been reduced to a minimum while preserving the generality of the external constraints acting on the tube and their time evolution. Results are stored on magnetic tapes, allowing both great flexibility in print-out and easy restart of an interrupted calculation. (auth)

16443 ALTERATION OF THE MAGNETIC PROPERTIES OF Au–Fe ALLOYS BY NEUTRON IRRADIATION. Borg, R. J. (Univ. of California, Livermore). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 317(1974).

From nineteenth conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P1.

Three alloys of Au–Fe containing nominally 13, 17, and 24 at.% Fe were irradiated to a total dose of $\sim 10^{19}$ neutrons/cm² (reactor

spectrum neutrons). The magnetic hyperfine splitting was measured by means of the Mössbauer effect for both irradiated and unirradiated specimens. Only the 17% alloy demonstrated a significant change in the temperature dependence of the magnetic order. However, the change for this composition was extreme; the magnetic order commencing at ~128°K for the irradiated specimen as compared with ~65°K for the unirradiated sample. These results demonstrate that short range compositional order has a profound effect upon the magnetic properties and that the effect is a function of bulk composition. (auth)

16444 DEVELOPMENT OF ION-BOMBARDMENT SURFACE STRUCTURES ON STAINLESS STEEL. Witcomb, M. J. (Univ. of the Witwatersrand, Johannesburg). J. Mater. Sci.; 9: No. 4, 551-563(Apr 1974).

A brief review is given of the formation and characteristics of conical surface structures resulting from ion etching. The effect of low-energy ion bombardment of 18-8 stainless steel surfaces is studied. The topography generated is related to microstructural detail. The conical protrusions are found to arise from slag silicate particles while the pillar type structures result from fibrous manganese sulphide inclusions. Scanning electron microscopy showed the development of both of these structure types to be in accord with previously published ion-etching models. (auth)

16445 EFFECT OF NEUTRON IRRADIATION ON FATIGUE CRACK PROPAGATION IN TYPES 304 AND 316 STAINLESS STEELS AT HIGH TEMPERATURES. Shahinian, P.; Watson, H. E.; Smith, H. H. (Naval Research Lab., Washington, DC). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 493-508 (1973).

Resistance to fatigue crack propagation of pre- and postirradiation AISI Types 304 and 316 stainless steels was determined at 800 and 1100°F using the fracture mechanics approach. The effect of irradiation on fatigue resistance was dependent upon test temperature and irradiation conditions. In general, irradiation degraded the fatigue resistance at 1100°F but at 800°F enhancement as well was observed. In both steels irradiated in a thermal reactor to a fluence of 1.8×10^{21} n/cm^2 >0.1 MeV, fatigue crack growth rates at 800°F were lower than in the unirradiated steels for a given stress intensity factor range (ΔK). However, at 1100°F, the effect was reversed and crack growth rates were higher in the irradiated steels. Irradiation in a fast reactor to a fluence of ~1.2×10^{22} n/cm^2 >0.1 MeV caused fatigue crack growth rates at 800°F to increase at low values of ΔK and decrease at high values of ΔK. At 1100°F, the crack growth rates in the irradiated steel were either the same as or higher than in the unirradiated steel. The influence of irradiation on fatigue life generally reflected the effect observed on crack growth rate. (9 figures, 23 references) (auth)

16446 RADIATION-INDUCED CHANGES IN THE FRACTURE EXTENSION RESISTANCE (R-Curve) OF STRUCTURAL STEELS. Hawthorne, J. R.; Watson, H. E. (Naval Research Lab., Washington, DC). Amer. Soc. Test. Mater., Spec. Tech. Publ.; No. 529, 17-28(1973).

The effects of irradiation on the fracture extension resistance of low- and medium-strength steel plates were explored using R-curve assessment procedures and four thick plates of A212-B, A302-B, A533-B, and A543-1 steel. The plates were specifically selected to depict a broad range of pre-irradiation dynamic tear (DT) upper-shelf toughness. Irradiations were conducted at <450°F and ~550°F. A subsize R-specimen (0.4 in. thick), patterned after the 5/8-in. dynamic tear specimen, was employed for pre- and postirradiation R-curve determinations. R-curves were constructed by plotting specimen energy absorption per unit fracture surface area against relative crack extension distance. Radiation exposure was revealed to have a highly detrimental effect on R-curve performance of all test plates regardless of their pre-irradiation shelf toughness level. The effect encompassed R-curve performance at temperatures corresponding to the dynamic tear upper shelf and at temperatures within the dynamic tear transition regime. The primary detrimental change for the upper-shelf condition was a reduction in R-curve level. A tendency for irradiation to reduce R-curve slope was also evident. The analysis suggests that, with sufficiently high fluence, neutron irradiation can cause a transition from rising R-curve to flat R-curve behavior at upper-shelf temperatures. (auth)

16447 HIGH VOLTAGE ELECTRON MICROSCOPY. Proceedings of the Third International Conference Held at Oxford, England, August 27-30, 1973. Swann, P. R.; Humphreys, C. J.; Goringe, M. J. (eds.). London; Academic Press (1974). 475p. £7.00.

The conference was divided into ten sections entitled; introduction, contrast, instrumentation, image recording and resolution, dynamic experiments, materials applications, radiation damage, environmental cells, biological applications, and ultra-high voltages. Seventy-seven papers were presented of which 12 were selected for inclusion in NSA. (SFL)

For abstracts of individual papers see: 16232-16234, 16380, 16448-16453, 16555, and 16556.

16448 EFFECT OF NEUTRON IRRADIATION ON THE PRECIPITATE DISTRIBUTION IN ADJUSTED URANIUM. Hudson, B.; Jackson, J. P.; Codd, I. pp 251-254 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

During neutron irradiation uranium undergoes cavitational swelling around 670°K. A series of alloys resistant to this swelling is adjusted uranium which contains alloying additions of iron and aluminum. The precise mechanism for the imparting of swelling resistance by additions of aluminum (which is particularly effective) is not known, but the distribution of the UAl_2 compound precipitates is thought to be important. To study the effect of neutron irradiation on such a distribution of UAl_2 the present work was undertaken. The sample preparation method is given. The precipitate distribution in adjusted uranium containing 585 ppM Al, 520 ppM Fe and 1000 ppM C before and after irradiation is shown. The precipitate density change and the measured amount of aluminum present in the observed precipitates assuming them all to be UAl_2 are tabulated which shows that the extra precipitates are formed as a result of an increase in total aluminum precipitated from solution and not as a result of redistribution of the pre-existing precipitates. The measured size-distribution before and after distribution clearly shows the extra fine precipitates formed. The results have an important bearing on swelling mechanisms since one possibility was that irradiation increased the amount of alloying element in solution, thereby perhaps slowing down the diffusion of vacancies to growing voids. This type of mechanism is now untenable and another model based on the ability of precipitates to stabilize the sub-grain structure formed has been proposed. (UK)

16449 ELECTRON IRRADIATION OF A MAGNESIUM ALLOY. Gelles, D. S. pp 348-352 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

A complex sequence of dislocation damage is found to develop in alloys of magnesium containing manganese during electron irradiation. The damage sequence is described and possible reasons for its development given. The sample was a solution treated alloy of magnesium -0.2 wt % manganese, irradiated in an Hitachi HU-1000 electron microscope operating at 1 MeV with a maximum flux of 3.1×10^{19} s^{-1} cm^{-2}. Ambient temperature was 60°C. As irradiation proceeds interstitial loops of both $\bar{a}$- and $\bar{c}$-type form, but continued irradiation causes them to disappear, to be replaced by vacancy $\alpha/6\langle 20\bar{2}3\rangle$ and $\alpha[0001]$ loops. The interstitial loop development is hampered by high fluxes and thin foils and vacancy loop development is enhanced by high fluxes. However, a situation where vacancy loops are more stable than interstitial loops (during irradiation) is unusual and requires careful consideration. A possible explanation is that, in magnesium, the surfaces of the foil are better sinks for interstitials than vacancies. (UK)

16450 ELECTRON IRRADIATION DAMAGE IN VANADIUM. Shiraishi, K.; Hishinuma, A.; Katano, Y.; Fukaya, K.; Taoka, T. pp 353-355 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

The behavior of radiation-produced dislocation loops in vanadium was investigated as a function of irradiation temperature up to 460°C. The dislocation loops observed in the specimens irradiated at 400 and 460°C were analyzed to have Burgers vectors of $\alpha/2\langle 111\rangle$ and to be on $\{111\}$ planes. Both interstitial and vacancy loops were produced by irradiation at 460°C. Although definite conclusions cannot be deduced at present, more than two-thirds of the loops produced at the central area with a high flux of electron illumination appeared to be interstitial in nature and most of the loops seen in the surrounding area with a low flux were vacancy in nature. (UK)

16451 STUDY OF A THERMAL POINT DEFECT MIGRATION AT LOW TEMPERATURES BY MEANS OF HIGH VOLTAGE ELECTRON MICROSCOPY. Urban, K. pp 356-360 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

The purpose of this work was to use the variety of experimental possibilities offered by in situ irradiation experiments at low

temperatures in a high voltage electron microscope to study the nature of athermal defect migration in the case of lead. Direct evidence was found for the existence of replacement collision sequences and a novel type of point-defect diffusion which is of radiation-induced nature. The most important consequence of this radiation-induced diffusion is that point defects can migrate to sinks, cluster, or annihilate mutually during irradiation even at temperatures where thermally activated migration is impossible. (UK)

16452 STUDY OF ELECTRON IRRADIATION DAMAGE IN A HVEM IN Ni AND Ni–Si ALLOYS AT VARIOUS TEMPERATURES. Hossain, M. K.; Brown, L. M. pp 360-364 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

For interstitial loops produced in the HVEM, the Brown, Kelly, Mayer [(Phil. Mag.; 19: 721 (1969)] model of nucleation and growth of the clusters predicted the limiting value of the interstitial loop density. This model appears to yield consistent and reasonable values for interstitial migration and binding energies. The influence of the surface of the sample on experimental results, the dependence of loop density on the flux of irradiation, and the effect of temperature and the introduction of impurities on loop density were investigated in Ni-Si alloys. It was found that (a) the surface correction is very important and the slopes of the corrected curves are considerably lower than the slopes of the uncorrected curves, (b) the 0.058% crystal behaved intrinsically, whereas the 0.35% alloy behaved extrinsically under the irradiation conditions used, (c) there is a rapid increase of slope at temperatures above 500°K. (UK)

16453 TIME-LAPSE CINE PHOTOGRAPHY ON THE EM7 MICROSCOPE, AND ITS USE IN RADIATION DAMAGE STUDIES. Makin, M. J. pp 365-369 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

A time-lapse cine photography method has been used for radiation damage studies in metals. The rate of local plastic straining is equal to $b\rho V$, where b is Burgers vector, ρ the density of climbing dislocations and V the rate of dislocation climb. The simplest and most convenient way to measure the quantity V is to make a cine film of the dislocation movement and then count the rate at which dislocations cross randomly chosen points on the screen in a given time. Dislocation flux measurements have now been made in nickel, copper, and 316 stainless steel, as a function of temperature. The nickel results show that the dislocation flux increases rapidly with temperature up to above 650°C during irradiation in the HVEM. The results on copper are interesting in that in this material it is possible to exceed the high temperature peak and determine the temperature (~650°C) at which the flux becomes zero due to the effect of thermal vacancies. (UK)

Other Materials

Refer also to abstracts 14981, 14999, 15343, 16321, 16373, 17471, and 17934.

16454 (ANL-CT-45824-7) SOME PRELIMINARY RESULTS OF THE CHANGES IN MECHANICAL PROPERTIES OF POLYARYLENE (STILAN) FOR COAXIAL CABLE APPLICATIONS DUE TO NEUTRON IRRADIATION. Popper, G. F. (Argonne National Lab., Ill. (USA)). 30 May 1974. 4p. AT.

At integrated neutron fluxes of 1×10^{18} nvt, little change in tensile strength was observed in Stilan. The percent elongation changed by less than a factor of two. At 2×10^{18} nvt, the tensile strength decreased by about a factor of two as did the percent elongation. Stilan therefore appears to be mechanically adequate at 80°F in a neutron environment and should be further studied for use in coaxial cable applications in gamma radiation environments. (auth)

16455 (CONF-700347-, pp vp, Paper 24) FABRICATION AND TESTING EPOXY MODELS UNDER THE COMPLEX STRESS STATE ACTIVITY. Derby, R. W. (Oak Ridge National Lab., TN). 1970.

From fourth annual heavy section steel technology information meeting; Oak Ridge, Tennessee, USA (31 Mar 1970).

In heavy section steel technology program.

As part of the Complex Stress State Task the HSST Support Group is investigating the interaction of cracks and nozzle corners. To accomplish this goal it was necessary to develop techniques for producing large numbers of epoxy model pressure vessels. Some of the problems encountered in making the vessels are discussed. For example, mold design, vacuum degassing, glued joints, release agents, stress relief, and material selection are included. Preliminary measurements of K_{Ic} and Young's modulus for the final material are reported. Current work on the variability of the stress-strain behavior is being developed with miniature tensile specimens. Preliminary results are presented. Two techniques have been used to produce cracks in K_{Ic} specimens. One method uses a controlled pop-in from a wedge, whereas the other relies on fatigue growth from a saw cut. The latter technique has also been used to produce large flaws in nozzle corners. An attempt is being made to develop a da/dN vs ΔK curve for beam-shaped specimens. The basic idea is to subject the specimen to a carefully planned loading history. After failure the specimen is sliced up, and the zones of different load intensity are examined under the microscope. A similar technique is being used on nozzle corners. (auth)

16456 (COO-3137-2) INVESTIGATIONS OF RADIATION EFFECTS IN SOLIDS BY ELECTRON SPIN RESONANCE. Final Report, June 15, 1957–April 14, 1971. Gilliam, O. R. (Connecticut Univ., Storrs (USA)). 31 May 1974. Contract AT(11-1)-3137. 32p. Dep. NTIS $4.75.

Studies were made on radiation effects in nonmetallic solids, using ESR to characterize point defects generated by the radiation. In early work γ-ray, reactor, and electron irradiation of α-Al_2O_3 was a major study and several defects were identified. Other work on metal oxides included limited investigations of γ-irradiated rutile, fused silica, and tetragonal GeO_2. The transition metal ions V^{4+} and Cr^{3+} in GeO_2 were also recently investigated by ESR. Defects in undoped and niobium-doped $CaMoO_4$ were studied following ionizing irradiations. The N_4^- molecular ion, N_3^- molecular ion, and trapped nitrogen atoms N^0 were identified in uv- or γ-irradiated KN_3; only N_3^- ions and N^0 atoms were found in RbN_3. Electron bombardment was required to generate defects in the bifluorides KHF_2, $NaHF_2$, and NH_4HF_2; in each material F_2^- ions were identified, caused by hydrogen atomic displacements. The CN molecule was studied by ESR in γ-irradiated KNCO. The activation energy for F'-to-F conversion in KCl was determined using ESR to monitor the F center signal strength. (65 references) (auth)

16457 (N-74-15657) THERMODYNAMIC PROPERTIES OF UF_6 AT HIGH TEMPERATURES. Hassan, H. A.; Deese, J. E. (North Carolina State Univ., Raleigh (USA)). Jan 1974. 36p. NTIS $3.00.

The equilibrium composition and the thermodynamic properties of the mixture resulting from the decomposition of uranium hexafluoride is calculated for temperatures ranging from 600 to 4000°K at pressures from 0.01 atmospheres to 10 atmospheres. (STAR)

16458 (TRG-Report-2537) INFLUENCE OF FAST NEUTRON IRRADIATION ON THE THERMAL EXPANSION OF PYROLYTIC GRAPHITE. Yates, B.; Pirgon, O. (Salford Univ. (UK); UKAEA Reactor Group, Risley). Apr 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

Earlier measurements of the linear coefficients of pyrocarbons used as fuel element coating agents were extended to specimens which have been irradiated with doses of 1.5×10^{21} fast neutrons/cm^2 (Ni DIDO) at 1110°C. Coupling the present measurements with the earlier ones in approximately the same temperature range, 300 to 800°K, it may be concluded that: (1) The linear thermal expansion coefficients α of pyrolytic graphite coatings derived from methane and propylene are identical. (2) Any influence of heat treatment at temperatures of 1275, 1800, and 1900°C upon α is below the detection limit. (3) The irradiation of the methane-based specimens by 1.5×10^{21} fast neutrons/cm^2 (Ni DIDO) at 1110°C produces no detectable change in α. (4) The irradiation of the propylene-based specimens by 1.5×10^{21} fast neutrons/cm^2 (Ni DIDO) at 1110°C reduces α by approximately one-third. Comparison of (3) and (4) with earlier works reveals that neither of these is without precedent. Quantitative assessments of preferred orientation parameters and accommodation coefficients were made for specimens before irradiation and for the propylene-based specimens after irradiation. It is concluded that both sets of material contain a higher proportion of c-axis thermal expansion than that found in a completely random aggregate of crystallites, but that the arrangement of the crystallites in the irradiated propylene-based specimens forms a closer approximation to this state. (auth)

16459 (TT-74-50011, pp 353-357) STUDY OF THE RESISTANCE OF FIBROUS FILTERING MATERIALS IN RAREFIED AIR. Petryanov, I. V.; Ogorodnikov, B. I.; Zimina, L. A. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The resistance of fibrous FP filtering materials in a flow of rarefied air is studied. The material resistance was found to decrease with increasing length of the mean free path of the gas

molecules, because the gas flow glides along the filter fibers, and at normal atmospheric pressure the resistance of almost all FP materials is already lower than its maximum. For FPP-5, LFS-2, and FPP-15 materials, which consist of ultrafine fibers, the loss of resistance is 10 to 20%. Higher compaction β leads to a slight additional drop in resistance from the maximum for the given compaction. The computations for the resistance of FP materials under gliding flow conditions are shown. A correction for gliding is recommended when $\lambda/\alpha_{vis} > 0.005$. (auth)

16460 SUGGESTED STRUCTURAL DESIGN CRITERIA FOR NUCLEAR GRAPHITES. Stancampiano, P. A. (O'Donnell and Associates, Inc., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 265-266(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16461 PROCESS FOR PYROLYTIC DEPOSITION OF BORON ON A METAL SUBSTRATE. Kuehl, D. K.; Fanti, R.; Galasso, S. F. (to United Aircraft Corp.). US Patent 3,811,930. 21 May 1974. Filed date 24 Nov 1969. 4p.

A process is described for pyrolytic deposition of boron on a substrate by bringing a pyrolytically decomposable gaseous boron-containing compound and a pyrolytically decomposable metal-containing gas into contact with a substrate, including a reducing gas at an elevated temperature sufficient to pyrolytically decompose both the boron-containing compound and the metal-containing gas. The boron is deposited on the substrate at a rate higher than could be obtained in the absence of the metal-containing gas. (Official Gazette)

16462 TENSILE FRACTURE OF BORON–EPOXY COMPOSITES WITH ORDERED FILAMENT PACKING GEOMETRY. Heimbuch, R. A.; Felbeck, D. K. (General Motors Technical Center, Warren, MI). pp 165-191 of Failure Modes in Composites. Toth, I. (ed.). New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1973).

From failure modes in composites symposium; Boston, Massachusetts, USA (8 May 1972). See CONF-720514-.

Observation of the detrimental effects of irregular filament spacing in aligned composites suggests that improvements may be made by better alignment. The tensile deformation and fracture behavior of composites of 100-μm boron filament in a matrix of Shell 828 epoxy with Z hardener are examined. Filament geometry included a single filament, a single layer of 25 filaments, and 5 layers of 25 filaments each, in both square and hexagonal cross-section patterns, with nominal filament volume fraction up to 58 per cent. Epoxy hardener ratios and cure cycles were varied so as to give matrix fracture strains from 0.05 to 0.10. Eight multilayer specimens with 33.9 per cent volume fraction of boron filaments in a square pattern fractured at an average stress of 105 ksi, a specific strength of 1.78×10^6 in. (45.2 km), and 71.4 per cent filament efficiency. For six specimens having 33.3 per cent volume fraction of filaments in a hexagonal pattern, the respective average values were 126 ksi, 2.14×10^6 in. (54.4 km), and 86.9 per cent. Thus the hexagonal pattern more effectively utilized the filaments. A total of 44 multilayer and 148 composite specimens of other geometries were tested in this program. Varying the interfacial strength by coating the boron filament was found to alter substantially the number of filament breaks before fracture. Use of a ductile rather than brittle epoxy matrix more than doubled the "yield" or knee stress and strain in 12 per cent filament volume specimens. (auth)

16463 STUDIES OF A NEW ESR CENTER IN X-IRRADIATED CaF_2 CRYSTALS. Nakata, R.; Kohno, K.; Sumita, M. (Univ. of Electro-Communications, Chofu, Japan). J. Phys. Soc. Jap.; 36: No. 1, 196-201(Jan 1974).

Electron spin resonance studies have been carried out on x-irradiated CaF_2 single crystals. A new ESR center is induced with x-irradiation at room temperature. This new ESR center exhibits well resolved super hyperfine structures. The ESR spectrum is analyzed with a spin Hamiltonian $\mathcal{H} = g\beta H \cdot S + \sum_{i=1}^{8} S \cdot a_i \cdot I_i$ with $S = 1/2$ and $I_i = 1/2$. The obtained spin Hamiltonian parameters are $g = 2.0007$, $|\alpha_s| = 10.6$ and $|\alpha_p| = 1.8$ gauss. The ESR center grows larger with x-irradiation time and its growth is saturated after irradiation of about 4 to 5 hours. The thermal decays of the ESR center are well approximated with the first order kinetics, and its activation energy is determined as $E = 0.47 \pm 0.05$ eV. The optical bleachings of the ESR center were also made in the range from 398 to 658 nm, and ESR signals were reduced most prominently at 580 nm. (auth)

16464 THERMAL CONDUCTIVITIES OF CARBON MATERIALS AND HOW THEY ARE AFFECTED BY IRRADIATION. Virgil'ev, Yu. S. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 10, 1517-1520(Oct 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 10, 1703-1707(Oct 1973).

Radiation effects on thermal conductivity and crystallite diameter of carbon materials are discussed. It is pointed out that the dependence of the thermal conductivities of carbon materials on their overall porosities is exponential. Direct proportionality of the thermal conductivity reduced to zero porosity to the diameter of the regions of coherent scattering is preserved after irradiation. (JRD)

16465 LOW-TEMPERATURE RECOVERY OF IRRADIATION DEFECTS IN n-TYPE GERMANIUM. Meese, J. M. (Univ. of Dayton, OH). Phys. Rev., B; 9: No. 10, 4373-4391(15 May 1974).

Defect concentrations introduced into lightly doped n-type germanium by 1.0-MeV electrons at 7°K were monitored by measuring the hot carrier-conductivity at 4.2°K during a 0.66-μsec pulsed electric field of 100 V/cm and 1-sec duty cycle. Approximately 85% of the damage produced at 7°K recovers in a thermal-annealing stage at 65°K. Isochronal- and pulse-isothermal-annealing experiments, performed simultaneously on pairs of samples doped with approximately equal concentrations of different group-V impurities, show that the 65°K annealing rate is dependent on the type of impurity. Radiation annealing was also studied by irradiating pairs of samples, damaged previously at 1.0 MeV, with low-energy electrons which produce little additional damage. The defects, which thermally anneal at 65°K, radiation anneal at 7°K with an annealing rate which is dependent on the type of group-V impurity dopant. This experiment suggests that one of the defects involved in these annealing processes is free to migrate over large distances near liquid-helium temperature. A model for the 65°K stage is proposed in which the annealing is initiated by the breakup of an interstitial group-V impurity complex which was formed during 1.0-MeV irradiation. The interstitial is treated as a freely migrating particle which, when freed from the complex, can either migrate to a vacancy or be retrapped at an unoccupied impurity depending upon the relative charge stages of these defects. From this model, it is possible to calculate the annealing rate of the 65°K stage, the 7°K-radiation-annealing rate, and the optical-annealing rates for optically stimulated annealing of the 65°K defects at 4.2°K during excitation with less-than-band-gap filtered light and at 30°K during excitation with monochromatic light of energy greater than the band gap. This model also predicts an interstitial migration energy of 0.005 eV as well as a temperature-dependent radiation-annealing rate in the 5–15°K temperature range in good agreement with recent data obtained by Hyatt and Koehler. (auth)

16466 EPR STUDY OF DEFECTS IN NEUTRON-IRRADIATED SILICON: QUENCHED-IN ALIGNMENT UNDER ⟨110⟩-UNIAXIAL STRESS. Lee, Y. H.; Corbett, J. W. (State Univ. of New York, Albany). Phys. Rev., B; 9: No. 10, 4351-4361(15 May 1974).

The stress effect in an EPR study is first treated rigorously in terms of the piezospectroscopic tensor, taking account of the local symmetry of a defect. It is found that the degree of alignment ($n_\perp/n_\parallel$) provides incisive information on the structure of a defect; in general, a nonplanar vacancy cluster results in $n_\perp/n_\parallel < 1.0$ and a {110}-planar vacancy chain gives rise to $n_\perp/n_\parallel > 1.0$. The results on the Si-P1 and Si-P3 spectra are reanalyzed. Based on the quenched-in alignment under ⟨110⟩ uniaxial stress, we confirm the assignment on the Si-P1 and the Si-P3 spectra to a negative charge state of nonplanar pentavacancy cluster and to the neutral charge state (spin 1) of the {110}-planar tetravacancy chain, respectively. Tentative models of the Si-A3 as a tetravacancy cluster and the Si-A4 spectra as a {110}-planar trivacancy chain are discussed. (auth)

16467 MAGNETIC PROPERTIES OF THE NEPTUNIUM MONOPNICTIDES. Aldred, A. T.; Dunlap, B. D.; Harvey, A. R.; Lam, D. J.; Lander, G. H.; Mueller, M. H. (Argonne National Lab., IL). Phys. Rev., B; 9: No. 9, 3766-3779(1 May 1974).

The magnetic properties of the neptunium monopnictides, NpN, NpP, NpAs, and NpSb, were examined by a variety of experimental techniques. All compounds have the NaCl structure. Results are reported for magnetization, Moessbauer, electrical-resistivity, neutron-diffraction, and lattice-parameter (x-ray) measurements between 1.5 and 300°K on polycrystalline samples prepared in the laboratory. Particular emphasis is placed on both the complementary information obtained by the different techniques, and how this helps to elucidate the microscopic magnetic behavior. Neptunium nitride is ferromagnetic with $T_c = 87$°K. Neptunium phosphide orders antiferromagnetically at 130°K with an incommensurate magnetic structure. At 74°K the magnetic structure becomes commensurate with the lattice (repeat distance 3.0 unit cells) and at lower temperatures tends to form a 3+, 3− sequence. A complete solution for the magnetic structure at low temperature is

obtained by combining the neutron and Moessbauer results. Neptunium arsenide becomes antiferromagnetic at $T_N = 175°K$. At ~160°K, the high-temperature 4+, 4− structure transforms to the type-I arrangement (simple +, − sequence). The crystal lattice of NpAs becomes tetragonal at T_N, exhibits a first-order transition to cubic symmetry at 142°K, and remains cubic at lower temperatures. The electrical resistivity increases by an order of magnitude on cooling from 142 to 141°K. Neptunium antimonide is a type-I antiferromagnet with $T_N = 207°K$. The variation of the ordered moments ($1.4\mu_B$/Np in NpN to $2.5\mu_B$/Np in NpSb), paramagnetic effective moment (~$2.5\mu_B$/Np), and the Moessbauer parameters (hyperfine field, quadrupole interaction, and isomer shift) all suggest a trend toward Np^{3+}, $5f^4$ free-ion behavior in progressing from the nitride to the antimonide. (auth)

16468 ACCOUNT OF SCINTILLATION EFFICIENCY FOR LOW-VELOCITY HEAVY IONS. Luntz, M.; Figueroa, J. (State Univ. of New York, Fredonia). Phys. Rev., B; 9: No. 1, 87-94 (1 Jan 1974).

The track-effect theory of scintillation efficiency is generalized for applicability at low velocities and applied to room-temperature pulse-height data (L vs E) for keV-energy heavy ions ($6 \leq Z \leq 80$) in CsI(Tl). By subtraction of the elastic-collision-loss contribution to the total energy, data are reduced to the form $dL/d\eta$ vs velocity, where $dL/d\eta$ is the differential light emission per unit of electronic energy deposit. It is found that agreement between theory and experiment is achieved over the entire range of the data with no specific role attributed to elastic scattering other than the consumption of a portion of the energy of the incident ion. The role of electron promotion in determining the pulse-height characteristics is examined. Those features of the model developed specifically for low-velocity application are presented. Results of the treatment and implications regarding the degree of applicability of the track-effect model are discussed. (auth)

16469 PROCEEDINGS OF THE ELEVENTH INTERNATIONAL CONFERENCE ON THE PHYSICS OF SEMICONDUCTORS, WARSAW, POLAND, JULY 25−29, 1972. Volume 1. New York; Elsevier Publishing Company (1972). 782p. (CONF-720744-P1).

From 11th international conference on the physics of semiconductors; Warsaw, Poland (25 Jul 1972).

Ninety-two papers were presented on various aspects of semiconductors, including magnetic properties, optical properties, excitons, and band structure. One item was selected for inclusion in Nuclear Science Abstracts. (SFL)

For an abstract of an individual paper see: 16470.

16470 MAGNETIC SUSCEPTIBILITY OF BORON AND AMORPHOUS-LIKE CRYSTALLINE SEMICONDUCTORS. Matyas, M. (Inst. of Solid State Physics, Prague). pp 569-575 of Proceedings of the Eleventh International Conference on the Physics of Semiconductors. New York; Elsevier Publishing Co. (1972).

From 11th international conference on the physics of semiconductors; Warsaw, Poland (25 Jul 1972). See CONF-720744-P1.

Magnetic properties of β-rhomboedric boron were investigated by measuring the temperature dependence of the magnetic susceptibility. It was found that this dependence is similar to that of semiconducting glasses. An interpretation is given showing some relation to the energy spectrum. It is shown that there exist also other crystalline semiconductors having the same properties. (auth)

16471 IMPURITY DEPENDENCE OF THE ANNEALINGS OF GAMMA-RAY INDUCED DEFECTS IN P-TYPE GERMANIUM. Ito, K. (Shimane Univ., Matsue, Japan); Saito, H. Jap. J. Appl. Phys.; 12: No. 10, 1475-1485(Oct 1973).

Annealing of radiation-induced defects in gallium- or indium-doped germanium was studied by measuring minority carrier lifetime. The samples were irradiated with ^{60}Co gamma rays at 190°K or at room temperature. Three annealing stages were observed in the temperature range 20 to 200°C. Activation energies and frequency factors of the low-temperature stage (20 to 60°C) were found to depend on the atomic size of the impurity. The activation energies were obtained to be 0.88 eV and 0.60 eV for indium- and gallium-doped samples respectively. A model for the stage is proposed as follows: An impurity-vacancy complex migrates to a substitutional impurity atom and makes an association. In the intermediate temperature stage (80 to 125°C) a deep trap grows up at the expense of a shallow trap. A recombination level at $E_v + 0.06$ eV is removed in the temperature stage above 130°C. The activation energy of the high-temperature stage is also dependent on the impurity species. (auth)

16472 RADIATION-INDUCED $Z_2 \rightarrow F$ CONVERSION IN ELECTROLYTICALLY COLORED ALKALINE EARTH DOPED KCl CRYSTALS. Damm, J. Z.; Nierzewski, K. D. Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 22: No. 4, 321-324(May 1974).

Ionizing radiation-induced conversion process of Z_2 centers into F centers in Ca, Sr and Ba doped KCl crystals is described. The process is explained in terms of high trapping ability of the holes by Z_2 centers. (auth)

16473 NUCLEAR SPIN-LATTICE RELAXATION IN FERROMAGNETIC EuO. Barak, J.; Gabai, A.; Kaplan, N. (The Racah Institute of Physics, The Hebrew University of Jerusalem, Jerusalem, Israel). Phys. Rev. B 9: No. 11, 4914-4919 (1 June 1974).

The spin–lattice relaxation time T_1 of Eu^{153} in powder EuO was measured at temperatures from 1.7 to 20 K and external fields above magnetic saturation from 24 to 60 kOe. The results were analyzed using the multimagnon scattering theory previously proposed by Beeman and Pincus. The observed relaxation rates are well explained by the dipolar–induced two–magnon process and exchange–scattering–enhanced three–magnon process. It is found that the first is dominant at low temperatures ($T < 14$ K) and the second at higher temperatures. (auth)

16474 f−f EMISSION FROM DIVALENT EUROPIUM IN MFCl PHASES (M = Ca, Sr, Ba) AND $BaLiF_3$. Tanguy, B.; Merle, P.; Pezat, M.; Foussier, C. (Universite de Bordeaux, Talence, France). Mater. Res. Bull.; 9: No. 6, 831-836(Jun 1974).

The luminescence spectra of the $M_{1-x}Eu_xFCl$ (M = Ca, Sr, Ba) and $Ba_{1-x}Eu_xLiF_3$ phases with PbFCl and perovskite structures show narrow lines corresponding to transitions inside the $4f^7$ configuration. (auth)

16475 RELATIVE INTENSITIES IN THE VIBRONIC ZEEMAN EFFECT IN CUBIC CRYSTALS. Pollack, S.P.; Satten, R.A. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. B 9: No. 11, 4628-4637 (1 June 1974).

Vibronic Zeeman intensity ratios are predicted for circularly polarized light propagation parallel to an externally applied magnetic field along [100] and [111] directions. A unique relative-intensity pattern is predicted for each type of site-symmetry vibration appearing in vibronic Zeeman patterns involving T_{1g} or T_{2g} electronic states. Experimental results in fields up to 62.8 kOe show semiquantitative agreement in most cases with predicted results for the ideal case of a limiting approximation in which T_{1u} and T_{2u}, etc., site-symmetry vibrations are not degenerate. Such degeneracy, rather than accidental, is typical of that required by the space-group symmetry of the crystal, and leads to departures from the limiting intensity ratios. Measurements of the departure from the limiting ratios can lead to the determination of the relative contribution of degenerate T_{1u}, T_{2u}, etc., site-symmetry vibrations. This information should provide quantitative data beyond that of zero-field vibronic intensity profiles in testing models for lattice-dynamics calculations applied to the vibronic interaction, or in evaluating necessary parameters of such models. Ideal π/σ vibronic intensity ratios for D_{3d} distortion of a cubic crystal field in zero magnetic field are also presented which explain certain observed polarizations not predicted by exact vibronic selection rules. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 14744.

16476 (BLG-490) ROLE OF MEASUREMENTS OF NUCLEAR MATERIALS IN SAFEGUARDS. Beets, C. (Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Mar 1974. 33p. Dep. NTIS (US Sales Only) $4.75.

An introduction to the role of technical measurements in safeguards is presented. The term "measurement" is defined as the process of obtaining numerical results from instruments or techniques to determine a value of a physical or chemical property or physical system. There are many general aspects of making measurements such as general use of destructive and nondestructive measurements, measurement errors, sampling, standards, combination of techniques, integration of operational and safeguards measurements, influence of measurements on operational procedures, role of portable and installed instruments, integral experiments. These general aspects in analyzing the role of measurements in safeguards are presented and discussed. (auth)

16477 (LA-UR-74-893) NDA MEASUREMENT ERROR DUE TO INSTRUMENT CALIBRATION. Smith, D. B.; Forster, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 10p. (CONF-740622-5). Dep. NTIS $4.00.

From meeting of institute of nuclear materials management; Atlanta, Georgia, USA (19 Jun 1974).

A meaningful quantitative measurement program for nuclear materials control requires not only instrumentation to assay special nuclear material, but also the ability to determine a statistically defensible estimate of the uncertainty in that assay. Expressions are presented which estimate the contribution from calibration to the uncertainty in the assay of both a single inventory item and an entire inventory. The latter case must include the fact that the results for all items assayed using the same calibration curve are correlated. A Monte Carlo model of the calibration-assay procedure which has been developed confirms the ability of these expressions to properly estimate the uncertainty due to calibration. This model and the results obtained are presented along with examples of the magnitude of this contribution. (auth)

16478 (LA-UR-74-913) NDA MEASUREMENT OF LOW-LEVEL U AND Pu WASTE. Umbarger, C. J.; Walton, R. B.; Foley, J. E.; Cowder, L. R. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 12p. (CONF-740622-6). Dep. NTIS $4.00.

From meeting of institute of nuclear materials management; Atlanta, Georgia, USA (19 Jun 1974).

The accurate analysis of low-level U and Pu wastes in a routine manner is an important step in implementing effective waste management and nuclear materials accountability programs. Several gamma ray and neutron based detection systems presently being used at LASL for analysis of such wastes are described. (auth)

16479 (LA-UR-74-924) FIELD ASSAY OF PLUTONIUM WITH A NEW COMPUTERIZED SEGMENTED GAMMA SCAN INSTRUMENT. Martin, E. R.; Jones, D. F.; Speir, L. G. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 21p. (CONF-740622-4). Dep. NTIS $4.25.

From meeting of institute of nuclear materials management; Atlanta, Georgia, USA (19 Jun 1974).

An automated passive gamma scanner for NDA is described, engineered around a minicomputer and an automated scan table. The computer permits virtual hands-off operation and offers a segment-by-segment profile of fissile content, as well as an estimate of the propagated statistical measurement error. Since the measurement is transmission corrected on a segment-by-segment basis, a wide variety of container sizes and material matrices can be accommodated, permitting two-percent measurements on scrap and waste samples containing between five and five-hundred grams of fissile material. Field tests of the new instrument at ARHCO in Richland, Washington, are also described. (auth)

16480 (LA-UR-74-977) NDA OF HTGR FUEL USING THE RANDOM DRIVER. Atwell, T. L.; Foley, J. E.; East, L. V. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 18p. (CONF-740622-3). Dep. NTIS $4.00.

From meeting of institute of nuclear materials management; Atlanta, Georgia, USA (19 Jun 1974).

The use of an active neutron source interrogation system known as Random Driver for the nondestructive assay of uranium in HTGR (in-process) fuel particles is described. The system employs a random source of fast neutrons consisting of four AmLi (α,n) sources to induce fissions in the ^{235}U present. Fission events are detected by coincidence counting of prompt-fission neutrons using a pair of fast plastic scintillation detectors. A PDP-11/05 minicomputer is used for data acquisition and reduction. Details of the assay system and preliminary results on the assay of HTGR fuel particles are presented. (auth)

16481 PROGRESS IN DEVELOPMENT OF TECHNOLOGY FOR NUCLEAR MATERIALS SAFEGUARDS. Bartels, W. C. (US Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 184-185(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16482 HALF-LIVES OF THE PLUTONIUM ISOTOPES AND ^{241}Am. Strohm, W. A.; Jordan, K. C. (Monsanto Research Corp., Miamisburg, OH). Trans. Amer. Nucl. Soc.; 18: 185(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16483 NONDESTRUCTIVE ASSAY OF PLUTONIUM AND URANIUM IN MIXED OXIDES. Weber, H. J. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 186-187 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16484 FISSION MULTIPLICITY DETECTOR FOR PLUTONIUM WASTE. Weber, H. J. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 187(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16485 ISOTOPIC CORRELATION SAFEGUARDS TECHNIQUES: RATIOS AND THEIR PROPERTIES. Christensen, D. E.; Prezbindowski, D. L. (Battelle Pacific Northwest, Richland, WA). Trans. Amer. Nucl. Soc.; 18: 187-189(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16486 VERIFICATION SAMPLING TECHNIQUES IN A SAFEGUARDS SITUATION. Stewart, K. B.; Schneider, R. A. AT(45-1)-1830. Nucl. Mater. Manage.; 3: No. 1, 12-19(Spr 1974).

Verification sampling techniques in a safeguards situation are used to detect whether the assigned amount values on materials of strategic importance are correctly stated within the limits of statistical measurement variation. A statistical study is presented which was undertaken to determine a sampling procedure which is robust and adequate against all diverter strategies. The general problem is treated in which (1) individual items have stated amounts and operator inspectorate individual differences are used to eliminate process variance component between items, (2) three critical regions inherent in the use of a combined attribute and variable testers are taken into account, (3) it is assumed the falsifications are distributed by a diverter in a way which minimizes the probability of detection, (4) conservative approaches are taken by the inspectorate at every turn, and (5) maxi-min and game theory approaches are used for comparison with crossover plan results. Game theory is used to provide a useful basis of comparison for results which are calculated by more immediate methods. One of the results of these studies has been to recognize that the development of adequate sampling plans in safeguards is more complicated than in ordinary acceptance sampling situations and the amount of sampling required is generally more extensive. (LCL)

16487 ELECTRONIC SECURITY DEVICES. Costanzi, F. Nucl. Mater. Manage.; 3: No. 1, 21-24(Spr 1974).

The operation and limitations of some electronic security devices applicable to nuclear facilities are described. The devices discussed include exterior intrusion alarms using microwave, infrared, ferrous metal, or pressure-sensitive detection systems; interior intrusion alarms using acoustic, light-sensitive, microwave motion, infrared, magnetic, or vibration detection system; and specific equipment for monitoring doorways, and detecting concealed metals and explosives on persons with authorized access to areas containing special nuclear materials. (LCL)

Disposal and Storage

Refer also to abstracts 15064, 15297, 15374, 15432, 15512, and 17866.

16488 (LA-5614-PR) TRANSURANIC SOLID WASTE MANAGEMENT RESEARCH PROGRAMS. Quarterly Report, October–

December 1973. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 59p. Dep. NTIS $5.45.

Progress for three transuranic solid waste management research programs funded by the AEC Division of Waste Management and Transportation during the period of October–December 1973 is reported. The interim storage criteria, which were reviewed by AEC administrative and contractor personnel, will be revised and submitted to AEC Headquarters for further comment. The experimental conditions for the studies of corrosion in humid air have been revised to better simulate conditions expected in closed-pad storage. In addition to bare mild-steel and stainless-steel samples, mild-steel coupons coated with several rust-inhibiting compounds are being studied. Radiolysis studies of typical waste materials contaminated with ^{238}Pu have thus far produced between 0.56 and 41.01 kPa of gas per simulated year. Waste sorting studies are being used to evaluate the newly developed Multi-Energy Gamma Assay System (box counter). Incinerator type and design feed rate have been selected for the Transuranic-Contaminated Solid Waste Treatment Development Facility, and operational parameters selected. The risk analysis method to be used in the evaluation of past burial practices has been described. Several parameters have been evaluated from literature sources, and equations to estimate organ doses have been derived. A radionuclide inventory of Los Alamos Scientific Laboratory (LASL) disposal areas has been compiled. (auth)

16489 (NLCO-1110) STUDY FOR DISPOSAL OF URANIUM CONTAMINATED FERROUS SCRAP. Shaw, W. E. (National Lead Co. of Ohio, Cincinnati (USA)). 25 Apr 1974. Contract AT (30-1)-1156. 115p. Dep. NTIS $8.75.

The radioactive waste disposal problem associated with the implementation of the CIP and CUP programs which will create large quantities of uranium-contaminated ferrous scrap was studied. Information is included on the types and quantities of scrap to be generated; disposal by smelting, by decontamination using chemical means, and by burial; the costs of these three methods; regulatory aspects of processing uranium-contaminated ferrous scrap and ultimately selling the product; and burial sites. (LCL)

16490 SHIPMENT AND DISPOSAL OF LOW-LEVEL WASTES. Tuite, P. (Hittman Nuclear and Development Corp., Columbia, MD). Trans. Amer. Nucl. Soc.; 18: 80-81(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16491 DIRECT SEARCH ALGORITHM FOR OPTIMIZING RADWASTE SYSTEMS. Flemming, K. N.; El-Bassioni, A. A. (Carnegie-Mellon Univ., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 138-139(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16492 EFFECT OF ACTINIDE REMOVAL ON THE HAZARD OF HIGH-LEVEL WASTE. Claiborne, H. C. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 190(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16493 METHODOLOGY FOR RISK ANALYSIS OF NUCLEAR WASTE MANAGEMENT SYSTEMS. Smith, T. H.; Winegardner, W. K.; Jansen, G.; Williams, L. D.; McSweeney, T. I. (Battelle Pacific Northwest, Richland, WA). Trans. Amer. Nucl. Soc.; 18: 191-192(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16494 ECONOMIC AND ENVIRONMENTAL EVALUATION OF NUCLEAR WASTE DISPOSAL BY UNDERGROUND IN SITU MELTING. Cohen, J. J.; Schwartz, L. L.; Tewes, H. A. (Lawrence Livermore Lab., Livermore, CA). Trans. Amer. Nucl. Soc.; 18: 194-195(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16495 LEAK OF TANK 106-T AT HANFORD. Robinson, R. A. Nucl. Safety; 15: No. 4, 460-466(1974).

An incident in which approximately 115,000 gal of radioactive liquid waste leaked from a 533,000-gal underground storage tank at the Hanford Plant of the U.S. Atomic Energy Commission in 1973 is reviewed. The ensuing investigation indicated that the leaked material was retained in the soil in the vicinity of the waste tanks and posed no threat to the workers and the nearby Columbia River. However, the investigation did point out the need for improved monitoring procedures, which are presently being implemented. (auth)

16496 ENVIRONMENTAL HAZARDS OF NUCLEAR WASTES. Micklin, P. P. Bull. At. Sci.; 30: No. 4, 36-42(Apr 1974).

The management of long-lived highly radioactive wastes from the nuclear industry, particularly wastes containing ^{85}Kr, ^{137}Cs, and ^{90}Sr, is discussed in terms of the waste quantities presently stored in federal repositories, hazards in present practices for the underground storage of liquid wastes, hazards in the transport of spent fuels, the anticipated ^{85}Kr release from fuel reprocessing plants, future underground storage schemes, and the need for evaluating waste management program to insure that the environment is not contaminated. (LCL)

Handling Equipment and Procedures

Refer also to abstracts 15858 and 17961.

16497 (ARH-3020) GUIDE TO FIRE PROTECTION IN CAVES, CANYONS, AND HOT CELLS. Lee, H. A. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Jul 1974. Contract AT(45-1)-2130. 92p. Dep. NTIS $5.45.

The advent and growth of the nuclear industry have required the development of unique facilities for handling intensely radioactive materials. These facilities, characterized by exhaust ventilation filtration for containment and massive shielding or other means for prevention of excessive radiation exposure to operating personnel, are referred to as caves, canyons, and hot cells. The maintenance of total containment while handling radioactive materials in caves, canyons, and hot cells is difficult at best; a fire occurring in these facilities greatly increases the difficulty. This guide presents information intended to aid in preventing such fires or, in the event of their occurrence, assist in minimizing their harmful consequences. (auth)

16498 HANFORD DECONTAMINATION FACILITY. Szulinski, M. J. (Atlantic Richfield Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 79-80(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16499 PROGRESS TOWARD CRITICALITY SAFETY STANDARDS FOR MIXED OXIDES. Clark, H. K. (Savannah River Lab., Aiken SC). Trans. Amer. Nucl. Soc.; 18: 160(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16500 STATUS OF CRITICALITY DATA AND EXPERIMENTS ON HOMOGENEOUS SYSTEMS OF PLUTONIUM–URANIUM. Bierman, S. R. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 160-161(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16501 STATUS OF EXPERIMENTAL CRITICALITY DATA FOR $(Pu,U)O_2$ FUEL RODS. Brown, C. L. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 161-164(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16502 CALCULATION-EXPERIMENT CORRELATIONS ON HOMOGENEOUS Pu-U SYSTEMS. Hall, R. J.; Bierman, S. R. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 164-165(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16503 CRITICALITY OF UO_2–PuO_2 SOLIDS IN FISSILE SOLUTION. Lloyd, R. C. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 165-166(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16504 MINIMUM CRITICAL MASSES OF WATER-FLOODED AND -REFLECTED ARRAYS. Hunt, D. C.; Schuske, C. L. (Dow Chemical Co., Golden, CO). Trans. Amer. Nucl. Soc.; 18: 170 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16505 NORMALIZED EQUIPMENT FOR HIGH-ACTIVITY INSTALLATIONS. Vertut, J. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 189, 3-41(Feb 1974). (In French).

The standardization of the French equipment has led to the utilization of independently operating devices. The following factors are discussed: standardization of master-slave remote handling equipment and its installation in hot cells; standardization of glove boxes, contained enclosures and accessories; standardization of transfer systems; and standardized elements of shielding and contained enclosures. (FR)

Transportation

Refer also to abstract 16490.

16506 (CONF-730588-) RADIOACTIVE SHIPMENTS THROUGH OUR STATES: THE WEAKEST LINK. Proceedings of the Second Annual Legislative Workshop, Oak Ridge, Tennessee, May 16-17, 1973. (Southern Interstate Nuclear Board, Atlanta, Ga. (USA)). [nd]. 123p. Dep. NTIS $5.45.

Fifteen papers were presented at the conference. A separate abstract was prepared for each of 14 papers. One paper appeared previously in NSA as 28:16154. (LCL)

For abstracts of individual papers see: 16507–16519 and 18015.

16507 (CONF-730588-, pp 1-10) PROBLEMS IN RADIOACTIVE MATERIALS TRANSPORTATION. Goodwin, J. T. (Southern Interstate Nuclear Board, Atlanta). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

Safety in the transport of radioactive materials requires trained personnel, specialized equipment, and the implementation of transport regulations. A study of regulations currently in effect showed that these regulations, if followed, reduce the probability of shipping incidents to close to zero, but that the regulations need to be simplified and that no adequate inspection program is in operation at either the federal or state level to insure that the regulations are complied with. The need for clarifying the responsibility and authority of state governments in inspecting shipments of radioactive materials and in responding to accidents involving radioactive materials is stressed. (LCL)

16508 (CONF-730588-, pp 14-30) NUCLEAR MATERIALS MOVING IN COMMERCE. Brobst, W. A. (Atomic Energy Commission, Washington, DC). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The shipment of nuclear materials in the US is reviewed. These shipments include radioisotopes for industrial and medical uses and materials related to the operation of nuclear power plants. The quantities have increased from 200,000 shipments in 1961 to approximately 800,000 shipments in 1971. Power plant related shipments are expected to increase by a factor of between 100 to 1000 by the year 2000. All modes of transport are involved. In 25 years no single injury or death has resulted from nuclear materials shipments. This record is the result of controlling the package design and limiting the contents shipped. Basic container types, quality assurance, package integrity and testing, accidents, state regulations, and special problems related to radioactive materials shipments are discussed. (LCL)

16509 (CONF-730588-, pp 43-46) INFORMATION PROBLEMS FOR STATE DECISION-MAKERS COVERING RADIOACTIVE MATERIALS MOVEMENT. Clement, R. N. (Tennessee Public Service Commission, Nashville). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The activities of the Tennessee Public Service Commission related to the intrastate transport of radioactive materials are discussed. (LCL)

16510 (CONF-730588-, pp 47-55) ROLE OF THE FEDERAL GOVERNMENT IN THE MOVEMENT OF RADIOACTIVE MATERIAL. Barker, R. F. (Directorate of Regulatory Standards, Washington, DC). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The role of the Federal government in the transportation of radioactive materials, the development of transport regulations, regulatory responsibilities in the government, regulations and standards applicable to the transport of radioactive materials, procedures for revising the regulations, and problems related to regulations enforcement are discussed. (LCL)

16511 (CONF-730588-, pp 56-70) CONSTITUTIONAL AND LEGISLATIVE AUTHORITY OF STATE GOVERNMENT IN THE TRANSPORTATION OF RADIOACTIVE MATERIALS. Tucker, J. G. [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The Atomic Energy Act of 1954, its relation to state regulations for radioactive materials, and court cases of conflicts between state and federal regulations are reviewed. The need for the state governments to develop regulations to insure the safety of intrastate shipments of radioactive materials and to coordinate regional regulations for interstate shipments is stressed. (LCL)

16512 (CONF-730588-, pp 71-75) AIR TRANSPORTATION OF RADIOACTIVE MATERIAL. Turner, W. W. (Delta Air Lines, Atlanta). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The experience of Delta Air Lines in handling shipments of radioactive materials, mainly radiopharmaceuticals, is reviewed. The need for simplifying and standardizing the regulations for shipping hazardous materials affecting the public and for better state and federal inspections for shippers and consignees is emphasized. (LCL)

16513 (CONF-730588-, pp 76-79) ROLE AND RESPONSIBILITIES OF THE RAILROAD INDUSTRY UNDER GOVERNMENT REGULATIONS. O'Driscoll, J. J. (Southern Railway System, Atlanta). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The experience of the Southern Railway System in handling and transporting hazardous materials, particularly radioactive materials, is reviewed, and procedures for complying with transport regulations and for developing plans for action for use in emergencies involving hazardous materials are described. (LCL)

16514 (CONF-730588-, pp 80-90) INTERGOVERNMENTAL RELATIONSHIPS IN THE TRANSPORT OF RADIOACTIVE MATERIALS. Beck, C. K. (Atomic Energy Commission, Washington, DC). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The development of regulations for the shipment of radioactive materials, areas where both the USAEC and the DOT within the Interstate Commerce Commission have duplicate authority and responsibility, and the division of responsibilities between the two agencies are discussed and related to continuing efforts to improve the safety of radioactive materials transport. (LCL)

16515 (CONF-730588-, pp 91-92 INTRASTATE SHIPMENTS AND INTERSTATE COOPERATION. Widerman, T. E. (Dept. of Motor Vehicles, Annapolis, MD). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

Although each state through which hazardous materials are transported has a basic responsibility for assuring the safety of that transport, cooperation between states involved in such shipments is essential. It is therefore recommended that a coordinating agency of similar composition be established within each state to expedite communication and cooperation for regulating and dealing with the shipment of hazardous materials. (LCL)

16516 (CONF-730588-, pp 93-95) PROMULGATION AND ENFORCEMENT OF STATE REGULATIONS. Priester, L. E. Jr. (Dept. of Health, Columbia, SC). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The role of state governments in assuming responsibility for the safe shipment of radioactive materials and for responding to emergencies related to such shipments is discussed. It is recommended that states enter regulatory agreements with the AEC and DOT, establish emergency response capabilities, and enter into interstate compacts for disaster response capabilities. (LCL)

16517 (CONF-730588-, pp 96-98) STATE RADIOLOGICAL HEALTH PROGRAMS AND EMERGENCY RESPONSE CAPABILITIES. Fry, R. M. (Dept. of Health, Frankfort, KY). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

State Radiological Health Programs as related to radioactive materials shipments and state emergency plans for dealing with accidents in such shipments are discussed. A plea is made to have state legislation and programs reviewed and revised to insure the greatest public safety and to promote interstate cooperation in achieving this safety. (LCL)

16518 (CONF-730588-, pp 99-109) RADIOACTIVE MATERIALS PROTECTION IN TRANSIT. Crowson, D. L. (Div. of Nuclear Materials Security, Washington, DC). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The safeguarding of nuclear materials in transit is discussed in terms of the potential for material diversion in the transportation cycle, elements of transportation safeguards, proposed legislation, special vehicle design, and the development of a secure communications system. (LCL)

16519 (CONF-730588-, pp 117-122) TRANSPORTATION OF RADIOACTIVE MATERIALS: A MEETING SUMMARY. Goodwin, J. T. (Southern Interstate Nuclear Board, Atlanta). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The work of the Southern Interstate Nuclear Board and of its legislative workshop on the shipment of radioactive materials through states is reviewed. It is concluded from the conference that the USAEC, DOT, and SINB are working together toward a common goal of preventing danger from the transport of radioactive materials and that states will soon react to encourage further development of programs in emergency response and in other nuclear-related areas. (LCL)

16520 (LBL-2168) ANALYSIS OF NEUTRON SHIPPING CONTAINER 6-GS-1. Wigle, G. L.; Bringham, P. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1974. Contract W-7405-eng-48. 72p. Dep. NTIS $5.45.

A safety analysis of the Model 6GS-1 Shipping Container for Type B quantities of gamma and neutron-emitting nuclides in special form is presented. Shielding materials are depleted uranium and a hydrated gypsum-spodumene composite. The analysis includes a description of the complete package, along with tabulated permissible quantities of specific nuclides, test data, and engineering evaluations required for compliance with AEC and DOT regulations. The DOT Special Permit is appended. (auth)

16521 IF-300 SPENT REACTOR FUEL SHIPPING CASK. Walker, E. (General Electric Co., Pleasanton, CA). Trans. Amer. Nucl. Soc.; 18: 168-170(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16522 FIELD TESTING OF A SYSTEM FOR COMMUNICATION WITH COMMERCIAL SNM SHIPMENTS. Sonnier, C. S.; Sellers, T. A.; de Montmollin, J. M. (Sandia Labs., Albuquerque, NM). Trans. Amer. Nucl. Soc.; 18: 185-186(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 14746, 16447, 17360, 17378, and 17382.

16523 (BNL-18938) AGS BEAM STRUCTURE. Fainberg, A.; Kalogeropoulos, T. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 6 May 1974. 6p. Dep. NTIS $4.00.

The beam bunch structure of an accelerator due to the radio frequency (rf) cavities can make one-counter time-of-flight (TOF) measurements possible. This is particularly of interest for neutral particles in which TOF is otherwise impossible. Prompted by interest in antineutrons, the AGS structure as observed at an external target is reported. (auth)

16524 (KHFTI-72-45, pp 3-6) OPERATING EXPERIENCE OF THE 2-GeV ELECTRON LINEAR ACCELERATOR IN 1971. Vishnyakov, V. A.; Grishaev, I. A.; Dobrolyubov, Yu. I.; Dem'yanenko, G. K.; Kobezskii, V. M.; Kondratenko, V. V.; Myakota-Moskalev, V. I.; Rubtsova, N. F. 1972. (In Russian).

A brief review is presented of the improvements introduced in some systems of the 2-GeV electron linear accelerator for the purpose of improving the operating characteristics. The basic modifications are the installation of 5 pairs of quadrupoles, installation of double pumps on the waveguide in the V4-generator room, separation of the absorbing load of the sections from the vacuum area with a connecting window and filling of the load with gaseous nitrogen under pressure, installation of teletypes, and testing of the hookup with the controlling device "Dnepr". Data on the time lost in operating the beam because of trouble in the accelerator system and other causes are reported. The operating experiences in 1971 are compared with those in 1970. (tr-auth)

16525 (KHFTI-72-45, pp 6-8) PRELIMINARY VERSIONS OF IMPROVING THE 2-GeV LINEAR ACCELERATOR PARAMETERS. Vishnyakov, V. A.; Grishaev, I. A.; Kobezskii, V. M. 1972. (In Russian).

Some possible versions for the improvement of the 2-GeV linear accelerator such as energy, current, energy spread, duty factor, and beam dimensions are examined. Improvement of the parameters is possible by the use of supplementary sections, extension of the accelerator with one-two by-pass channels, creation of a storage ring on top of the accelerator to serve as a device for a counter-beam, construction of an installation to increase the duration of pulsed monochromatic particles, and by construction of magnets with variable field to permit increase of the maximum beam energy. Stabilization of the beam parameters can be achieved by introduction of automatic maintenance of the individual beam parameters within given limits and by introduction of an automation complex for the computer control of the entire accelerator. (tr-auth)

16526 (KHFTI-72-45, pp 19-21) LABORATORY ONE-SECTION ELECTRON LINEAR ACCELERATOR. Vishnyakov, V. A.; Afanas'ev, V. D.; Rudychev, V. G.; Telegin, Yu. N. 1972. (In Russian).

A design for a one-section accelerator with sufficiently high angular capture at electron injection energies of the order of 100 keV and characteristics of the accelerated beam are described. The accelerator consists of an iris waveguide section with phase velocity of the waves equal to the speed of light and an attachment of about 30 cm with graduated change of the phase velocity of the wave and the intensity of the accelerating field. The parameters of the wave attachment for injection energies of 80 keV are reported, and the results of the calculation of the accelerator parameters are given. (tr-auth)

16527 (KHFTI-72-45, pp 81-83) EXPERIMENTAL INVESTIGATION OF THE STABILITY OF THE U-17 ACCELERATOR MODEL OUTPUT PARAMETERS. Vikulov, V. F.; Oblezin, V. A.; Ostanin, V. A.; Shabrov, V. A.; Yanenko, V. V. (Moscow Engineering-Physics Inst.). 1972. (In Russian).

Studies on the stability of the current and electron energy in the U-17 accelerator are described. The operating characteristics of the accelerator were studied in all ranges of adjustment of the accelerator parameters with the purpose of determining the sensitivity of the output parameters to a variation of the system parameters. The instability of the current and electron energy was studied as a function of time. The factors causing these changes were established. The dependence of the electron current and energy on the value of the line voltage was shown. It was concluded that stabilization of the voltage supplying the accelerator to 0.2 to 0.3% improves the stability of the beam current and electron energy 5 times. (tr-auth)

16528 (KHFTI-72-45, pp 84-86) MEASUREMENT OF THE 25-MeV ELECTRON BEAM EMITTANCE. Emel'yanov, V. K.; Rogoza, A. N.; Shestak, V. P. (Moscow Engineering-Physics Inst.). 1972. (In Russian).

Experiments on the determination of the energy loss of the beam with differing currents in the transition and stationary regime of the operation of the traveling wave linear accelerator are described. The results obtained were compared with calculated data. The measurements were made with a magnetic analyzer. The experimental errors were evaluated. (tr-auth)

16529 (KHFTI-72-45, pp 99-101) OPTIMIZATION OF THE LINEAR ACCELERATOR OPERATING TEMPERATURE. Grishaev, I. A.; Kheifets, M. I.; Zykov, A. I. 1972. (In Russian).

The problem on the determination of the optimum operating temperature of accelerators at which the energy consumption for the acceleration of charged particles and for the cooling of the acceleration structure was a minimum was solved analytically. The optimum operating temperature depends on the form of the temperature dependence, the efficiency of the cooling installation, and the efficiency of the uhf generator. The results of the determination of the optimum working temperature are reported as a function of the type of accelerator structure. (tr-auth)

16530 (KHFTI-72-45, pp 102-104) ELECTRON LINEAR ACCELERATORS WITH THE CIRCULATION OF HF-ENERGY AND OF THE ACCELERATED BEAM. Levin, V. M.; Rumyantsev, V. V.; Ryabtsov, A. V.; Smirnov, V. L. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). 1972. (In Russian).

The advantages of using double transmission of the beam through the accelerator in comparison with usual accelerators are examined. This accelerator scheme is intended for increase of the energy increase per unit length of the accelerator. The electron efficiency is used as the criterion of quantitative comparison. A formula for the determination of the electron efficiency is derived. It is shown that during circulation of the beam the efficiency of the accelerator in the low current region is sharply increased. At high beam currents the efficiency is improved after one acceleration. (tr-auth)

16531 (KHFTI-72-45, pp 106-109) POSSIBILITIES OF ELECTRON LINEAR ACCELERATOR RECONSTRUCTION BY USING SUPERCONDUCTING MATERIALS. Levin, V. M.; Orlov, A. K.; Rumyantsev, V. V.; Ryabtsov, A. V.; Smirnov, V. L.; Sokolov, B. A. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). 1972. (In Russian).

The possibilities for the reconstruction of operating linear electron accelerator by using superconductors are examined. On the basis of this examination a system for the multiple circulation of the beam through the superconducting structure is proposed. The characteristics of two variations of accelerators using superconductors are calculated and tabulated. (tr-auth)

16532 (KHFTI-72-45, pp 115-117) RESULTS OF ONDULATOR SYNCHROTRON START UP. Ziyakaev, R. G.; Fomenko, G. P.; Chuchalin, I. P.; Yushkov, Yu. G. (Tomsk Polytechnic Inst., USSR). 1972. (In Russian).

The characteristics of the accelerating system of the undulator synchrotron with resonators in the form of shortened cut-off sections of the smooth waveguide are described. The results of the calculation of the parameters of the uhf generator for the production of accelerator current of 0.5 amp in 10-MeV pulses are reported. The results of the experimental study of the acceleration regime in the undulator synchrotron at the electron accelerator with energy up to 2 MeV are given. (JSR)

16533 (KHFTI-72-45, pp 117-119) INDUCED RADIOACTIVITY AT THE 2-GeV LINEAR ELECTRON ACCELERATOR. Krasnikov, A. A.; Posmetukhin, A. M.; Shustov, S. S. 1972. (In Russian).

The conditions and the reasons for the accumulation of radioactivity at the 2-GeV electron linear accelerator are examined. The radiation environment at the accelerator was evaluated. The materials from which the accelerating sections, electron guides, and deflecting magnets are constructed seem to be the basic areas for the accumulation of induced radioactivity. It was observed that the level of radiation from the induced activity depends on the duration of the operation of the accelerator, the beam intensity, and the characteristics of the materials. The following parts showed an increase in radioactivity: collimator of the system for beam shaping, Ta target for the production of positrons, chamber of the deflecting magnets, and monochromator. The radiation level at the monochromator is caused principally by

^{58}Co and ^{60}Co. The activity of units constructed of different steels is caused by ^{54}Mn. The isotopes were identified by a multichannel analyzer with semiconductor detector. (tr-auth)

16534 (NP-20039) ANNUAL REPORT, 1973. (Science Research Council, Daresbury (UK). Daresbury Nuclear Physics Lab.). 1974. 163p. Dep. NTIS (US Sales Only) $11.25.

Work carried out at the Daresbury Laboratory in 1973 is reviewed. The fields covered include high-energy physics (NINA), the synchrotron radiation facility, the nuclear structure facility, computing and electronics, engineering and health and safety. (UK)

16535 (RLO-1388-248) UNIVERSITY OF WASHINGTON THREE-STAGE TANDEM VAN DE GRAAFF ACCELERATOR. Weitkamp, W. G.; Schmidt, F. H. (Washington Univ., Seattle (USA)). 1973. 44p. Dep. NTIS $5.25.

The 3-stage Model FN Tandem Van de Graaff accelerator at the University of Washington and its operating characteristics are described. With the 3-stages, the machine produces proton and deuteron beams up to 0.6 μA in intensity at energies up to 25.5 MeV. The neutral-negative system is now being replaced with a terminal source so as to increase the energy and versatility of the 3-stage configuration. Various improvements to the accelerator and the ancillary equipment have been made since initial operation (1965). These include new ion sources, a polarized ion source, beam stabilization systems, and miscellaneous other equipment. Maintenance problems and procedures are also discussed. The accelerator combination has proved to be a versatile and relatively reliable instrument for a wide variety of nuclear research. (auth)

16536 (SZS-153, pp 247-255) CONTRIBUTION OF NEUTRONS TO THE TOTAL RADIATION EXPOSURE AT REACTORS AND ACCELERATORS OF THE ZfK ROSSENDORF. Adler, B.; Damm, C.; Kneschke, H.; Rossbander, W. (Zentralinstitut fuer Kernforschung, Dresden). Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

The contribution of neutrons to the total radiation exposure of persons working at reactors and accelerators can be objectively estimated only by considering operating conditions as well as the working place and time. Investigations in ZfK for representative groups of workers showed that: (1) high radiation exposures are found only in pure gamma radiation fields; and (2) the mean annual neutron dose equivalent at the reactors and accelerators of ZfK amounts to less than 3% of maximum permissible radiation exposure. Periodical individual neutron monitoring is considered to be unnecessary for workers at these facilities. (auth)

16537 PARTICLE IRRADIATION METHODS. Raju, M. R. (Los Alamos Scientific Lab., NM); Lyman, J. T.; Tobias, C. A. pp 115-140 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

Techniques for space radiobiological studies using particle accelerators at ground level are discussed. Topics include the biological use of accelerators, radiation detectors, beam measurements, irradiation techniques, and future accelerator capabilities. (WDK)

16538 "DRIFTRON" METHOD OF CHARGED PARTICLE ACCELERATION. Vodop'yanov, F. A. Tr. Radiotekh. Inst.; No. 11, 121-137(1972). (In Russian).

A look is taken at the construction and principles of operating a "Driftron"-accelerator, in which particles revolve along a cylindrical or conical spiral and the particle drift along this spiral is accelerated with time. The particles are accelerated by the electric field of a resonator. In the accelerating slits of the resonator there is developed either a high frequency voltage of constant frequency, which is synchronized with the time that the particle beam intersects the slit, or a high frequency voltage having a rectangular wave form, whose period is a factor of 4 to 5 greater than the particle drift time. (SJR)

16539 SUPERCONDUCTING, 900 MeV, ISOCHRONOUS CYCLOTRON. Babenko, B. F.; Vodop'yanov, F. A.; Dushin, Yu. F.; Kalinin, A. A.; Litvinov, V. N.; Helidov, A. B.; Sarkisyan, L. A.; Tagintsev, Yu. F. Tr. Radiotekh. Inst.; No. 11, 90-99 (1972). (In Russian).

Studies are presented on the possibility of using an isochronous 900-MeV proton accelerator with superconducting windings as an injector for an 18-GeV synchrotron having a 40 Hz following frequency and 2.5×10^{13} particles. (SJR)

16540 SUPERCONDUCTING SYNCHROTRON WITH VARIATION OF THE MAGNETIC FIELD THAT IS STATIONARY WITH TIME BY MECHANICAL MEANS. Vodop'yanov, F. A.; Tagintsev, Yu. F. Tr. Radiotekh. Inst.; No. 11, 111-120(1972). (In Russian).

A superconducting cyclic accelerator is considered whose magnetic system is formed by magnets having a constant field, which are moved directly by mechanical means in accelerating the charged particles. The accuracy tolerances in moving the magnets, and the field and gradient tolerances were determined. The required relation for changing the magnetic field along the radius was determined, and the configuration of conductors for forming a given field with an accuracy of 1% was found. The study considers resonance excitation of mechanical oscillations of the magnets. The required parameters of the system are given. (SJR)

16541 PRODUCTION AND FOCUSING OF POSITRON BEAMS. Ferdinande, H. M. A. Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1973). 167p. (In Dutch).

Thesis.

An electron beam hitting a heavy target produces positrons. The following aspects were studied: production and concentration of positron beams with a linear accelerator, the phenomenon of electron-positron conversion (the conversion spectra obtained are in good agreement with experimental data), the behavior of a relativistic positron in a magnetic field in order to compare different systems for beam concentration, and the conversion of a linear electron accelerator to a positron accelerator. (tr-auth)

16542 DISPERSED BREMSSTRAHLUNG OF THE 42 MeV BETATRON. Caha, A.; Krystof, V.; Ott, O. (Onkologicky Ustav, Brno). Jad. Energ.; 20: No. 4, 121-123(Apr 1974). (In Czech).

Results of measurements of exposures of dispersed bremsstrahlung of a betatron in the volume of an irradiation room are given. The energy of radiation in the measured points is evaluated. The film method, which is used in the governmental dosimetric service, was used for the measurements. The energy of the radiation was determined from the ratio of apparent blackening behind a vacuum field and behind a Pb filter 1 mm thick, which secured a condition of electron balance for dispersed bremsstrahlung. The results are summarized in the conclusion. (auth)

16543 EUROPE'S SUPER ACCELERATOR (300 GeV) COMES INTO OPERATION. Atoomenerg. Haar Toepass.; 16: No. 4, 92-96(Apr 1974). (In Dutch).

Two articles on the super proton synchrotron which appeared in November and December 1973 in the CERN courier are summarized. The machine is a development on the lines of previous experience, and can deliver 10^{13} protons per pulse; the injection time is 23 μs in place of the 2 μs of the previous pulse synchrotron, and special ferrite-cored magnets are used. Preliminary tests suggest that this accelerator will lead to fundamental information concerning neutrinos, pions, kaons, protons and anti-protons. (auth)

16544 USE OF ACCELERATORS FOR STUDIES IN CHEMISTRY. Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). pp 62-68 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Possibilities of applying accelerators of different types to applied and theoretical chemistry and photochemistry and mesochemistry are examined. (INIS)

16545 CHARGED PARTICLE ACCELERATORS FOR USE IN INDUSTRY AND MEDICINE. Komar, E. G. (Scientific-Research Inst. of Electrical Apparatus, Leningrad). pp 69-81 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The construction features and basic characteristics are described for the following accelerators: linear accelerators and betatrons (LUZ-5, LUZ-25, B5M-25, and BIM-45) used for medical purposes; accelerators (RTE-1, Electron, LUZ-8-5V, LUZ-15-10) used for industrial radiation-technical processes and sterilization; the linear accelerators LUZ-10-1 and LUZ-15-1.5 and the x-ray defectoscope RTD-1 used for defectoscopy; and the pulse generators used for activation analysis. The general form of some accelerators is shown. (INIS)

16546 REVIEW ON COLLECTIVE ACCELERATION METHODS. Kolomenskii, A. A. (Inst. of Physics, Moscow); Sarantsev, V. P. pp 107-118 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

A brief review is given on the basic questions discussed by the symposium on collective acceleration methods. Methods of ion acceleration using electron rings, particle acceleration in plasma and electron beams, and the production and formation of high-current electron beams are discussed. The general form and the circuits for individual elements of the accelerator are shown. (INIS)

16547 ACCELERATION PROCESSES IN A HIGH CURRENT ACCELERATOR OF THE LINOTRON TYPE. Levin, V. M.; Rumyantsev, V. V.; Ryabtsov, A. V.; Smirnov, V. L.; Shchepin, Yu. P. (Scientific-Research Inst. of Electrical Apparatus, Leningrad). pp 137-139 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

A theoretical study of the processes of multiple passages of a beam through the accelerating system in a high-current accelerator of the linotron type is described. The case of double passage of the beam is examined. The unsteady transition process from a regime of particle acceleration without circulation to an acceleration regime with circulation of the beam is analyzed. (INIS)

16548 FIRST OPERATION OF A SUPERCONDUCTING PROTON ACCELERATOR. Brandelik, A. (Univ., Karlsruhe, Ger.); Citron, A.; Flecher, P. pp 204-210 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The specific features of the pilot superconducting proton linear accelerator with a final energy in the region of 50 MeV and a current of 1 mA are briefly described and the main parameters of the first section of the accelerator, a superconducting helix operated at 90 MHz, are given. The beam focusing is achieved by superconducting lenses inserted between accelerating sections. The cryostat is 3 m long and can accommodate 3 accelerating sections and 3 lenses. It is cooled by helium and has about 15 W of heat losses. A double vacuum system is employed. Some problems connected with the poor mechanical stability of the helix are pointed out. The results of the initial operation of the accelerator are summarized. (INIS)

16549 LINATRON AS A MULTI-PURPOSE ELECTRON ACCELERATOR. Gonella, L.; Barbero, D.; Pasino, V.; Strigazzi, A. pp 119-122 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The specific features of the 500-MeV Linatron (Linac-powered race-track microtron) designed for nuclear research with precise, intense, high-duty beams with high-energy very short pulses, for neutron research with time-of-flight techniques and high-intensity neutron pulses, for research with massive irradiation at low energy, are described. The Linatron design parameters are given and its scheme is shown. (INIS)

16550 TRIUMF, THE MESON FACTORY IN VANCOUVER, CANADA. Richardson, J. R. (Univ. of British Columbia, Vancouver). pp 288-301; 317 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

TRIUMF is a meson factory based on a sector-focusing cyclotron accelerating H^- ions to 500 MeV. The magnet contains over 4000 tons of 10-16 steel and requires an excitation power of 3000 kW. It is now complete and is under test. The design pressure in the vacuum chamber of 4×10^{-6} torr is achieved by cryopumping at a temperature of 20°K. The resonators have been manufactured from "roll-bond" panels and constitute a quarter-wave line at 23 MHz. They are excited by four radiofrequency amplifiers combined in pairs to give the 1600 kW of rf power that will be required to give the desired 400 keV maximum energy gain per turn. The initial version of the ion source and injector system has been tested and the H^- beam has been injected into a full scale model of the central region on the cyclotron. (INIS)

16551 PROSPECTS FOR SUPERCONDUCTING SYNCHROTRONS. Thomas, D. B. (Rutherford High Energy Lab., Chilton, Eng.). pp 176-190; 233 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The work in progress in Europe towards a superconducting synchrotron is reviewed. The development status and main parameters of pulsed superconducting magnets are given. Model superconducting magnets have been constructed by the Group for European Superconducting Synchrotron Studies and tested for thousands of cycles of pulsed operation. The next stages in the work will involve redesigning these magnets in a more highly engineered form suitable for quantity production and then demonstrating their reliability over millions of cycles of operation. Some results of the development of magnet power supplies and refrigeration system for the 1,000 GeV synchrotron are also given. (INIS)

16552 ACCELERATOR OF THE DRIFTOTRON TYPE. Vodop'yanov, F. A. (Radiotechnical Inst., Moscow). pp 130-132 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

A plan for a driftotron is described. A driftotron is a circular accelerator in which the particles are accelerated by hf fields while they are moving in spiral equilibrium orbits in an axially symmetric magnetic field intensifying along the symmetry axis. The magnetic channels of the driftotron are formed by two coaxial coils, one of which has the form of smooth tubes and the second the form of tubes with variable radius. The stability of movement of the particles along the spiral orbits is achieved because the coil creating the field on the equilibrium orbit was varied in size by the change of the distance of this coil from the equilibrium orbit. A calculation is made of the basic characteristics of accelerators of this type. (INIS)

16553 BEAM EXTRACTION AND PASSING INTEGRAL RESONANCES IN THE TWO-STAGE CYCLOTRON FOR THE 3.7 GeV KAON FACTORY. Sarkisyan, L. A. (Radiotechnical Inst., Moscow). pp 302-304 of Proceedings of the Third All-Union Conference on the Charge Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Possible parameters of a two-stage cyclotron ~3.7-GeV kaon factory with an average beam current of ~100 μA are described. The first stage is a ring cyclotron with energy ~900 MeV and serves as a pion factory. Injection into the first stage can be done with a ~70 MeV cyclotron. A low magnetic field H_0 and large radius, high accumulation of energy per revolution, and rigid tolerance for the lowest harmonic of the field in the integral resonance zone are the primary characteristics of the ~3.7 GeV second state. The suprathreshold particles K^+, K^-, K^0, Λ, Σ^+, Σ^0, and θ can be obtained. These characteristics were realized in different degrees in the 500 and 590 MeV pion factories built in Vancouver and Zurich. (INIS)

16554 ACCELERATORS AND MEDICINE. Blokhin, N. N. (Inst. of Experimental and Clinical Oncology, Moscow). pp 43-54 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The present status and future prospects for the use of accelerators (particularly betatrons), linear accelerators, and microtrons for solution of the basic diagnostic and therapeutic problems of oncology in the USSR are examined. Recently attention has focused on proton beams with energies up to 200 MeV and π^- beams with energies from 25 to 100 MeV. Examples of the successful clinical use of the proton beam of the JINR and ITEF for the radiation treatment of tumors are given. (INIS)

16555 RECENT DEVELOPMENTS IN HIGH-VOLTAGE ACCELERATORS AND GENERATORS. Strojnik, A. pp 85-92 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

It is shown that the requirements of an electron microscope operating at an accelerating voltage in the 100 kV to 3 MV range are that the theoretical resolving power chromatic aberration be less than 0.2 nm, that the total instability be less than 10^{-5} for thin specimens, the high voltage instability be 4.10^{-6} during the final focussing and exposure and that the required emission current decreases with the voltage, usual values being 10 to 20 μA at 100 kV and 1 to 5 μA at 1 MV. Engineering problems in creating voltages of the order of 1 MV, stable to a few parts per million (which includes the ripple, random noise, and the voltage drift) are considerable, and the fact that low current is required is of little help. Frequently used designs of symmetrical cascade generators are shown. Stabilization of the primary voltage sources and control of the production of the high voltage are considered. High stability of the accelerating voltage is a necessary but not sufficient condition for an instrumental low chromatic aberration. It is further required that the accelerating system show a high and very stable electrical resistance, so as to represent a highly constant load for the high-voltage generator. The optics, the size and the weight of high voltage electron generators are discussed. (UK)

16556 ELECTRON ACCELERATORS FOR HIGH VOLTAGE ELECTRON MICROSCOPY (HVEM). Reinhold, G.; Gleyvod, R. pp 93-97 of High Voltage Electron Microscopy. Swann, P. R. (ed.). London; Academic Press (1974).

From third international conference on high voltage electron microscopy; Oxford, England (27 Aug 1973).

In the twin-tank accelerator, developed and designed in 1967, the accelerating voltage is generated by a symmetrical cascade generator and applied to the accelerating tube via the high ohmic damping resistor. In view of the trend towards higher voltages and improved resolving power, up-graded models of the electron accelerator were developed. Today, one may choose between maximum operating voltages of 1 MV, 1.2 MV, and 1.5 MV. The only difference in design or physical dimensions for the electron

accelerators at 1.0 MeV and 1.2 MeV are the voltage controls. The higher operating voltage is achieved by reducing the overvoltage, which may be applied to condition the accelerating tube. For the 1.5 MeV accelerator, both the high-voltage generator and the accelerator structure were extended in voltage by increasing the number of stages. The physical dimensions of the pressure vessels, however, remained unchanged. As compared with the standard stability of $\pm(1 \times 10^{-5})$, improved models with a stability of $\pm(5 \times 10^{-6})$ or even $\pm(1 \times 10^{-6})$ are available. A new system for the filament supply by means of a high-frequency transmission system has been introduced. The difficulties of avoiding interference from many different kinds of sources when ripple and stability are required to be below approximately 1 V are discussed. Taking these interference problems into account, a 600 kV electron accelerator is now under construction which is designed to have a stability of 500 mV per minute and a ripple of 600 mV peak to peak. (UK)

16557 MEDICAL APPLICATIONS OF CYCLOTRONS. Glass, H. I. (Hammersmith Hospital, London). pp 287-298 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

By 1974 at least fourteen medical cyclotrons will be in operation in seven countries as well as five commercially operated cyclotrons. These machines are used for the production of radionuclides, neutron therapy and in vivo neutron activation analysis. The clinical applications of cyclotron-produced radionuclides are discussed under four main categories: (1) localization, (2) electrolyte spaces, (3) organ function, and (4) blood flow. Recent experience in the use of cyclotron-produced neutrons for radiotherapy and in vivo activation analysis are also discussed. (auth)

Auxiliaries and Components

Refer also to abstracts 15705 and 17296.

16558 (ANL-Trans-955) MECHANICAL EXCITATION OF SUPERCONDUCTING HELIX RESONATORS BY EXTERNAL SOURCES WITH SLOWLY VARYING FREQUENCY. Schulze, D.; Hornung, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Mar 1974. Translation by A. H. Jaffey of KFK-Ext.-3/74-3. 27p. Dep. NTIS $4.50.

Helix resonators, which are used for rf-acceleration of protons and heavy ions, are very sensitive against mechanical induced disturbance sources. In particular, it is shown that sources with slowly changing frequency may lead to considerable resonant amplitudes even if the mechanical resonance is passed very fast. Thus, a substantial distortion of the operating accelerator is to be expected. A further enhancement may result if the resonance is passed several times in short intervals. This cumulative effect is particularly efficient for superconducting niobium cavities, whose mechanical damping factor at low temperatures is two orders of magnitude smaller than at room temperature. In addition to a theoretical analysis and model measurements, countermeasures are discussed. (auth)

16559 (JAERI-M-5454) AUTOMATIC VOLTAGE CONDITIONER FOR THE JAERI 5.5 MV VAN DE GRAAFF ACCELERATOR. Sato, Y.; Yoshida, T. (Japan Atomic Energy Research Inst., Tokyo). Nov 1973. 17p. (In Japanese). INIS.

An automatic voltage conditioning device built for the JAERI 5.5 MV Van de Graaff accelerator is described and also its operational performance. It can condition the accelerator to a required energy without surveillance. It has built-in features to safeguard against seven abnormal situations in the operation of the accelerator. (auth)

16560 (KHFTI-72-45, pp 17-18) TUNING OF THE UHF GENERATOR ON TRAVELING-WAVE TUBE AND MEASUREMENT OF THE LOADED QUALITY OF THE STABILIZING CAVITY RESONATOR. Beloglazov, V. I. 1972. (In Russian).

A method for the tuning of the UHF generator is proposed. A method is also proposed for the measurement of the loaded quality. With this method it is possible during the tuning of the generator to measure the quality of the stabilizing resonator and the external circuits determining specific values of the loaded quality of the resonator. A block diagram of the generator in the traveling-wave tube was given and the variation of the frequency of the generator during change of the phase of the V4 signal is shown. (tr-auth)

16561 (KHFTI-72-45, pp 18-19) AUTOMATIC UHF BLOCKING SYSTEM DEVELOPMENT. Antipov, K. I.; Dobrolyubov, Yu. I.; Dovbush, L. S. 1972. (In Russian).

The characteristics and operating principles of an automatic system for the blocking of a klystron pulse amplifier from breakdown into uhf channels are described. As a result of the introduction of the automatic uhf blocking system the uncoupling of stages of the linear electron accelerator was reduced by a factor of 7 and the number of failures were reduced 30%. The effective operating time of the accelerator was increased 150 hr in the year. (tr-auth)

16562 (KHFTI-72-45, pp 69-70) PRECISION CONTROLLED POWER SUPPLY FOR ACCELERATOR FOCUSING LENSES. Kirichenko, V. G.; Skubko, V. A. 1972. (In Russian).

A transistorized circuit for the precision control and stabilization of the power supply for focussing lenses is presented. (JSR)

16563 (KHFTI-72-45, pp 70-71) UHF-GENERATOR WITH A POWER TRAVELING WAVE TUBE IN AN OUTPUT CASCADE. Beloglazov, V. I.; Sdobnova, L. N. 1972. (In Russian).

The possibility of using a power pulse traveling wave tube in the final cascade of the uhf driver of the electron linear accelerator of the Physics-Technical Institute was studied. It is shown that the traveling wave tube is suitable for use as an output cascade of the highly stable driver on the large linear accelerator. (tr-auth)

16564 (KHFTI-72-45, pp 74-75) FACILITY FOR TESTING A PULSE KLYSTRON MODULATOR WITH THE OFF-DUTY FACTOR 1000. Vishnyakov, V. A.; Gorokhovatskii, F. S.; Gladkikh, M. A.; Dobrolyubov, Yu. I. 1972. (In Russian).

The circuit and basic characteristics of the dynamic test stand of the pulse modulator of the klystron with an off-duty factor of 1000, developed for testing the uhf device, the accelerating section, the waveguide channel, and other electrical apparatus, are described. The circuit of the pulse modulator is constructed on the principle of complete discharge of the storage ring. The modulator consists of the following basic units: storage lines, commutator, pulse transformer, control system, and shielding. An oscillogram of the voltage pulse of the modulator test stand is given. (tr-auth)

16565 (KHFTI-72-45, pp 87) MEASUREMENT OF THE BREMSSTRAHLUNG GAMMA-RADIATION SPECTRA WITH A TOTAL ABSORPTION SPECTROMETER. Grishaev, I. A.; Krinitsyn, A. N.; Lapin, N. I.; Pugachev, G. D.; Shramenko, B. I. 1972. (In Russian).

The results of the measurement of the spectrum of the bremsstrahlung γ beam obtained on the 2-GeV electron linear accelerator are reported. The measurements were made with a Cherenkov total absorption shower spectrometer based on a KRS-6 crystal in the form of a cone with base dimensions of 50 and 135 mm and height of 105 mm. The measurement results showed that the total absorption shower spectrometer can be used for the direct measurement of the energy spectrum of high energy γ quanta under the conditions in the linear electron accelerator. (tr-auth)

16566 (KHFTI-72-45, pp 95-97) FABRICATION TECHNOLOGY AND OPERATING SAFETY OF THE AIN-50 TITANIUM ION-SORPTION PUMP. Dement'ev, V. K.; Martynov, A. I.; Myakushko, L. K. 1972. (In Russian).

The basic characteristics of the X AIN-50 Ti ion-sorption pump are reported. The development work on the fabrication of the working elements of the pump, testing of the pump, and adjustment of its defects is described. An analysis is made of the behavior of the pump in operation. The statistical probability of reliable operation of the pump as a function of the on-time of the pump is shown. The positive results in the use of the AIN-50 pump at the 90-MeV accelerator made it possible to omit evacuating the high-vacuum chamber of the collector at the 380-MeV accelerator using a steam-oil pump and to alter the design of the vacuum system of the 2-GeV accelerator under construction. (tr-auth)

16567 (KHFTI-72-45, pp 119-122) ACCELERATING STRUCTURE FOR A PROTON LINEAR ACCELERATOR AT HIGH ENERGIES. Andreev, V. G.; Pirozhenko, V. M. (Radio Technical Inst., Moscow). 1972. (In Russian).

An accelerating structure for the proton linear accelerator, realized in the form of a cavity resonator with conducting discs and iris in which $E/2$ waves are excited with a sign-changing electrical field along the axis, is described. The results of the numerical calculation of the geometric form and technical parameters of the accelerating structure were reported. The experimental data according to the dispersion formula and the sensitivity of the accelerating field to errors of manufacture are also reported. (tr-auth)

16568 EXPERIENCE WITH INTERACTIVE CONTROL SOFTWARE AT THE CERN PROTON SYNCHROTRON. Carpenter,

B. E. (CERN, Geneva). pp 51-56 of Software for Control. London; Institution of Electrical Engineers (1973).

From conference on software for control; Warwick, England (17 Jul 1973).

A summary is presented of the technical objectives of the CERN 28 GeV proton synchrotron and of the present computer on-line control system. It is stated that the system includes, in addition to the central computer (a 40K IBM 1800 operated under disc-based multi-programming software) a Varian 620 used for real-time function generation and two Imlac PDS1 display minicomputers used as operator consoles. The configuration is being expanded to include 3 PDP-11/45's and links with other on-line computers associated with the synchrotron, and the present survey of interactive control software in use with the old configuration was carried out as part of the planning of this expansion. The various means of computer access available to the synchrotron operators and development engineers are described, and the associated software is outlined. One of the more flexible pieces of software, an on-line syntax handler, is discussed in more detail. (UK)

16569 SOFTWARE SYSTEM FOR OPEN LOOP CONTROL OF A SYNCHROTRON VIA SPECIAL PURPOSE CONSOLES. Benincasa, G. P.; Daneels, A.; Heymans, P. (CERN, Geneva). pp 57-62 of Software for Control. London; Institution of Electrical Engineers (1973).

From conference on software for control; Warwick, England (17 Jul 1973).

Most of the physics experiments performed at CERN require protons with an energy of 28 GeV. This is obtained in three stages: a linear accelerator, Linac, where the protons are created and brought to 50 MeV; next a first circular accelerator, Synchrotron Injector or Booster, where they reach 800 MeV; and eventually the high energy synchrotron, PS (Proton Synchrotron), where they are accelerated to the required top energy. In contrast to the Linac and PS, the Booster has been designed very recently and is still running-in. From the beginning, it was intended to be fully computer controlled, i.e. acquisition and/or control of most of its variables. Whereas the computer control has always been implemented both at PS and Linac in parallel with an existing "manual" control system, at the Booster its design could be imbedded within the study of the overall project. To save on hardware, emphasis was laid on the software system which is described in this paper. The operation of the Booster involves the control of about 700 variables: setting of currents and voltages, positioning of mechanical devices, selecting of timings, etc. Furthermore, the intention was to have several operators working simultaneously on different subsets of the machine, especially during setting-up. This implied the need for simultaneous access to well-defined parts of the accelerator (injection line, rings and transfer line) through the computer. Therefore, special operation consoles, called MIDICONSOLES, driven by computer were designed. However, when the machine is tuned, it is desirable to have one central access point, which will be called MAXICONSOLE, from where every machine subset may be controlled. This also allows more sophisticated controls for machine study. (auth)

16570 INTERPRETIVE SOFTWARE FOR A LARGE ONE-OFF PROCESS. Crowley-Milling, M. C.; Hyman, J. T.; Shering, G. E. (CERN, Geneva). pp 63-67 of Software for Control. London; Institution of Electrical Engineers (1973).

From conference on software for control; Warwick, England (17 Jul 1973).

The use of interpretive software for computer control, with particular reference to the multi-computer control system for the new European synchrotron (CERN II synchrotron), is discussed. In this context an interpreter is defined as a computer program which accepts high level control language source code as data input and gives the required control action as output directly, thus bypassing the usual steps of compilation, linking and running. This approach offers many advantages which can greatly reduce software effort, both for applications programming and in system design. The disadvantage is slow execution of interpretive programs or, put another way, increased computing power requirements for a given application. This is a reasonable trade-off in these days of falling hardware costs, especially for a one-off project. Also, the advantages and disadvantages of interpretive software are discussed in the context of the planned synchrotron computer control system, and the application of interpretive software for some prototype work is described. (auth)

16571 MEASUREMENT OF THE BEAM EMITTANCE OF THE MODEL OF THE 1-GeV CYBERNETIC ACCELERATOR BY THE DNEPR-1 CONTROL DIGITAL COMPUTER. Ivanova, G. P.; Kurasov, V. V. pp 20-28 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

An automatic system is described for measuring, by the 2-slit method, the emittance of a beam upon its injection into the vacuum chamber of an annular accelerator, used as a model of the 1-GeV cybernetic accelerator at the Radiotechnology Institute of the USSR Academy of Sciences. The method is described briefly. The slit arrangement is controlled automatically by the Dnepr-1 control digital computer. A block diagram of the automatic measurement system is given. The algorithm for the measurement is shown, which is in a program occupying, jointly with the constants and operating cells, 2½ blocks (512 cells to a block). Measurement results are printed in a form convenient for constructing graphs. Phase "portraits" of the beam at the injector exit are shown. The measurement time, determined by the slit movement rate, averages 1 hr 20 min in the vertical and horizontal planes for fixing 100 coordinates per plane. (tr-auth)

16572 EFFECT OF DYNAMIC CHARACTERISTICS OF CYCLIC ACCELERATOR CONTROL SYSTEM ON CONTROL DIGITAL COMPUTER OPERATION PARAMETERS. Pilyugin, V. V.; Savinov, Yu. N. pp 81-94 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The effect of the dynamic properties of the system of cyclic accelerator control, in which the change in disturbance is quasi-periodic, on the control digital computer operating parameters was studied. These include the algorithm structure, memory volume needed, and frequency of input and output of information. As an example of regulation of the equilibrium orbit, a method is given for constructing calculational schemes and for studying, using these schemes, the relation of the dynamic characteristics of the system (precision, stability, freedom from interference, and amount of regulation) to the number of small cycles and to the scale coefficient of the algorithms. (tr-auth)

16573 PROBLEMS IN EXPERIMENTAL EVALUATION AND ENSURING OF ACCURACY OF THE ORBIT-CONTROL SYSTEM FOR A CYCLIC ACCELERATOR USING A DIGITAL COMPUTER. Zabrodin, L. D.; Pilyugin, V. V. pp 50-59 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

Experiments on the effect of beam parameters on the characteristics of input information are described and the results of a qualitative evaluation of the distortion of the operating signals at the input and output tracks of the system are presented. To increase the precision of the input information, a method of numerical filtration—statistical averaging is recommended. The dependence of the precision of the input information on the beam intensity, the error due to nonidentity of the indication channels, and instrumental error are evaluated. The total error of input tracks of information transfer to the correction system of the equilibrium orbit of the accelerator using a digital computer is 12.9%. The chief contribution to the distortion of the output information introduces interference through the general impedance for the output channels and the executing apparatus. An effective method for excluding their effect is change of the analog form of the signal transfer to numerical. The total error of the output track for orbit control is 5.6%. Conclusions are drawn concerning the fact that the basis of the algorithm equations should be a method for statistical regulation with adaptation elements. (tr-auth)

16574 SPECTRAL COMPOSITION OF THE CORRECTING MAGNETIC FIELD IN THE CYCLIC-ACCELERATOR EQUILIBRIUM ORBIT SYSTEM. Zabrodin, L. D.; Pulyugim, V. V. pp 29-41 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The problem was solved mathematically of decreasing the executing output channels of the computer used in the control of correction of the equilibrium orbit of the cyclic accelerator. Specifically, the number of executing channels can be decreased by correction of signals of different channels. The azimuthal distribution of the correction signal is presented as the sum of a definite assembly of azimuthal harmonics. The correction of the equilibrium orbit is brought to the entry between the computer and the coupling apparatus of the regulating system for the orbit of the passive matrix—the correction signal amplifier. Then the number of computer outputs will equal the number of azimuthal harmonics of the matrix. The algorithm used for determining the number of matrix amplifiers is described. From it a program was developed for the M-20 computer, which occupies 380 cells of the memory. The initial data for the program are the parameters of the magnet structure and of the control system of the 1-GeV cybernetic accelerator of the Radio-Technology Institute of the USSR Academy of Sciences. The correction signals originate in the statistical data of the control system for the equilibrium orbit of the accelerator. The possibility of controlling the equili-

brium orbit by the intermediate matrix-multiplier signals was verified. (tr-auth)

16575 CONNECTION OF THE MAGNETIC FIELD PROBE WITH THE DNEPR-1 CONTROL DIGITAL COMPUTER IN THE ACCELERATOR MAGNETIC-FIELD CORRECTION SYSTEM. Baryshnikov, N. K.; Dzergach, A. I. pp 42-49 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

A block diagram is described and the features of a 3-scale inducing apparatus for coupling the controller of the magnetic field of a cyclic accelerator with the Dnepr-1 digital computer is described. This apparatus was developed to increase the precision of measurement of the magnetic field parameters from 250 gauss to 10 kgauss. The controller can be switched in with the nonunified output signal to the control computer of a serial model without decreasing the precision of transfer of information. The use of supplementary coupling apparatus imposes definite requirements on the program of information recorded in the computer. Operation of the computer on a special program, including the question of channels, the primary processing of input information, and control of coupling apparatus is synchronized with the accelerator cycle by a time-setting unit (time-meter). A typical time diagram of machine operation is shown. The described apparatus and program solutions were checked experimentally on the accelerator-Dnepr-1 computer system in a simulated acceleration regime. The results verified that coupling of the program and apparatus methods ensure relative errors of 0.1% in recording information. (tr-auth)

16576 CYCLIC ACCELERATOR MAGNETIC FIELD DISTORTION CORRECTION WITH A CONTROL DIGITAL COMPUTER. Baryshnikov, N. K.; Dzergach, A. I.; Kostikov, Yu. D. pp 72-80 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

Based on the proposed subject correction, a self-adjusting algorithm was developed. Three operating regimes are described for the computer: synthesis of a multipolar (preliminary) regime, alignment regime, and correction regime. A time diagram for the computer was designed and modeled on the EVM M-40. In developing the system the features of the 1-GeV cybernetic accelerator of the Radio-Technology Institute of the USSR Academy of Sciences were considered. The proposed method for solving the problem of current distribution in supplementary pole windings allows construction of a field of any construction with direct calculation of current values. (tr-auth)

16577 USE OF THE CENTRAL COMPOSITION PLANNING METHOD OF THE EXPERIMENT FOR THE MULTISECTION LINEAR ACCELERATOR CONTROL BY A DIGITAL COMPUTER. Smirnov, O. I.; Chalyi, V. D. pp 95-104 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The problem of shortening the output time of an accelerator in an automatic regime, defined by the requirements of the experiments carried out on linear electron and proton accelerators was studied. The problem may be solved by using a digital computer when there is a mathematical model for a given regime. The first and obligatory stage in creating the empirical and mathematical relations is the development of algorithms and construction of programs for determining the coefficients of the equations of the empirical mathematical models relating the input and output parameters of the accelerator. The method and program for this are described in detail for the extreme experiment carried out by the method of central composition planning of the experiment. The equations obtained were used for constructing nomograms for the optimum accelerator equations with the use of electronic calculators. (tr-auth)

16578 DEVICE FOR CONVERSION AND INPUT OF DATA ON THE CYCLIC-ACCELERATOR-BEAM BETATRON OSCILLATION FREQUENCY INTO THE CONTROL DIGITAL COMPUTER. Bel'man, L. B.; Dmitriev, A. P.; Kurasov, V. V.; Solov'ev, G. N.; Sosenskii, N. L. pp 60-70 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

A method was investigated for automatic measurement of the frequency of betatron oscillations of the beam in a cyclic accelerator. The features are described, and there are shown a block diagram and a functional scheme of the structure for converting information from the beam location-indication system, serving for determination of the betatron oscillation frequency, to a form ready for input to the control computer (Dnepr-I) used with the 1-GeV cybernetic accelerator of the Radio-Technology Institute of the USSR Academy of Sciences. Time diagrams showing the operation of the forming chains and the synchronization scheme of the accelerator are given. Possible errors and their sources are discussed. (tr-auth)

16579 EFFECT OF THE REGULATING SYSTEM ON THE TYPE OF STABILITY OF THE OSCILLATORY SYSTEM OF AN ACCELERATOR RESONATOR INTERACTING WITH THE BEAM. Titov, N. K. Tr. Radiotekh. Inst.; No. 11, 33-43(1972). (In Russian).

Adjustment processes in an accelerator are considered in the presence of a system that automatically regulates the amplitude and voltage phase of the resonator. An analysis is conducted of the slow and fast processes of regulating and determining the connection between the parameters of the automatic regulation system and those of the accelerator circuit. The amount of tuning between particular frequencies of the generator circuit and of the resonator circuit is shown. (SJR)

16580 METHOD FOR OPTIMIZING THE ARRANGEMENT OF CONCENTRIC WINDINGS OF AN ISOCHRONOUS CYCLOTRON AND OF THE CURRENTS IN THE WINDINGS. Babenko, B. F. Tr. Radiotekh. Inst.; No. 11, 100-110(1972). (In Russian).

As an example of selecting the arrangement of concentric windings of an isochronous cyclotron and the currents in the windings a solution is sought to the problem of a configuration of a current region and a distribution of currents in this region which assures a given structure of the magnetic field of the required accuracy in the working region. The problem is solved in two stages. In the first stage by a method of integral equations the problem is solved on the most suitable arrangement of the current region, and in the second stage by linear programming methods a selection is made of the current densities in the windings. (SJR)

16581 SUPERCONDUCTING ACCELERATING RESONATORS WITH VARIABLE FREQUENCY TUNING. Litvinov, V. N. Tr. Radiotekh. Inst.; No. 11, 148-156(1972). (In Russian).

The problem is investigated for the place and method of turning on a superconducting rotating condenser in order to decrease the electrical energy in the condenser and the maximum voltage on it, by means of which it is possible to attain tuning of accelerating resonators of synchrotrons with an accuracy of $\Delta f/f \sim 10^{-5}$. For finer tuning a proposal is made to use a small ferrite modulator with tuning of $\sim 10^{-3}$. In this case the minimum Q-factor of the resonator is equal to 10^4. Selection of a number of accelerating resonators is carried out with the purpose of decreasing the power required from the circuit. (SJR)

16582 AUTOMATIC MEASURING COMPLEX FOR STUDIES ON MESON FACTORY ACCELERATING RESONATORS. Zverev, B. V.; Ponomarenko, A. G.; Rusin, V. V.; Sobenin, N. P. (Moscow Engineering Physics Inst.). pp 254-257; 315 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators, Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The characteristics of automatic measurement complexes designed for the measurement of the field amplitude in the resonator space with an error not greater than ±1%, measurement of the distribution of the phases of the field with an error no greater than ±1.5%, and determination of the figure of merit of the resonator are described. One of the complexes was constructed on the basis of traveling wave tubes and the other on the basis of reflecting klystrons. The functional circuits of these complexes are given. (INIS)

16583 MESON FACTORY hf SUPPLY RELIABILITY PROBLEMS. Volkov, V. S.; Ivanov, Yu. D.; Klimov, A. F.; Polyakov, B. I. (Radiotechnical Inst., Moscow). pp 269-270 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

A theoretical study was made on the problems of guaranteeing the hf power supply of the linear accelerator of proton-meson factories. It is shown that the power supply can be guaranteed by emergency arrangements. An evaluation was made of the reliability of the hf feed systems using emergency arrangements. (INIS)

16584 OPTIMIZATION OF THE CONDUCTOR CONSUMPTION IN SUPERCONDUCTING MAGNETS. Babenko, B. F. (Radiotechnical Inst., Moscow). pp 195-199 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The method for the calculation of the optimum use of conductors in superconducting magnets is described. The results of the calculation of the windings, forming the mean field of the isochronous cyclotron and guide field of the driftotron, are reported. (INIS)

16585 EXPERIMENTS IN CONSTRUCTING MAGNETS WITH A VARIABLE MAGNETIC FIELD FOR A SUPERHIGH-ENERGY ACCELERATOR. Alekseev, V. P.; Vasil'ev, A. A.; Galst'yan, E. A.; Mironov, E. S.; Popokin, L. A. (Radiotechnical Inst., Moscow). pp 163-175; 233 of Proceedings of the Third All-Union

Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The experimental study of superconducting pulse magnets developed for proton synchrotrons with an energy of several thousand GeV is described. The basic parameters and the results of the testing of the pulsed solenoids and dipole magnets are reported. The experimental equipment used during the study of the superconducting magnets is briefly described. (INIS)

16586 RESIDUAL FIELDS IN SUPERCONDUCTING MAGNETS. Greben, L. I.; Galst'yan, E. A.; Mironov, E. S. (Radiotechnical Inst., Moscow). pp 200-203 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators, Moscow; Izdatel'stvo Nauka (1973). (In Russian)

Theoretical and experimental studies of frozen residual fields in dipole superconducting magnets are described. The results obtained showed that damping of the frozen current occurring in the superconducting core leads to the appearance of residual fields and to distortion of distributed field which can indicate particles in the accelerator existing during injection. Probably during operation of the superconducting magnets of the synchrotron it is necessary to select the material and diameter of the cable core not only on the basis of a consideration of loss to the applied current but also consideration of the distortion of the injection field. (INIS)

16587 EXPERIMENTAL SUPERCONDUCTING QUADRUPOLE LENS WITH A MAGNETIC FIELD GRADIENT OF 1 kG/cm AND AN APERTURE OF 65 mm. Tagintsev, Yu. F. Tr. Radiotekh. Inst.; No. 11, 142-147(1972). (In Russian).

A description is given of a quadrupole lens with a winding made of Nb-Ti wire. The lens is designed for a field with a gradient of 1 kG/cm. The useful aperture of the lens is 65 mm in diameter; the outer diameter of the lens is 160 mm; its length is 210 mm; and the weight is ~8.5 kg. (SJR).

16588 POSSIBILITY OF CRYOGENIC PUMPING-OUT OF A PROTON SYNCHROTRON. Budkin, V. A.; Glazkov, A. A. (Moscow Engineering Physics Inst.). pp 214-216 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators, Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The possibility of creating a superhigh vacuum $<10^{-7}$ torr in the vacuum chamber of the ~2000-GeV proton synchrotron was examined. The sorption and desorption processes on clean surfaces in the vacuum chamber during the use of a cryogenic pumping method when their area is sufficient to insure the vacuum operating cycle were studied. (INIS)

Ion Sources and Injection and Extraction Systems

16589 (JINR-P9-7954) CALCULATION OF THE REGENERATIVE SYSTEM OF THE BEAM EXTRACTION TO THE IRON-CURRENT CHANNEL OF THE PHASOTRON WITH SPATIAL MAGNETIC FIELD VARIATION. Vorozhtsov, S. B.; Dmitrievskii, V. P.; Zaplatin, N. L.; Kol'ga, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The process of excitation of radial free oscillations for the beam extraction from the phasotron with spatial field variation was numerically simulated using a computer. The maximum efficiency of the beam extraction was 68%. The emittance and the energy beam spread on the entrance to the extracting channel were found. (auth)

16590 (KHFTI-72-45, pp 15-17) AUTOMATIC SYSTEM FOR ELECTRON BUNCH PHASE PRESERVATION AT THE INJECTOR ACCELERATOR OUTPUT. Vasil'ev, E. P.; Mufel, V. B.; Vishnyakov, V. A. 1972. (In Russian).

The operating principles of the system for the automatic control of the phase of the electron bunch are described and a block diagram is given. The distinctive feature of the proposed scheme is that the mixer compares signals not with the input and output of the klystron but with the output uhf signals of the klystron and the beam phase. Results obtained in the operation of the system are reported. A change in the parameters at the output of the 2-GeV accelerator during variation of the parameters of the injection klystron is shown. (tr-auth)

16591 (KHFTI-72-45, pp 59-63) STUDY ON THE BEAM BENDING SYSTEM OF THE 1.5-GeV SYNCHROTRON INJECTOR. Ivanchenkov, V. P.; Dyugai, P. A.; Shilyagina, L. V. (Tomsk Polytechnic Inst., USSR). 1972. (In Russian).

The problem of bending the beam around an optical axis during the transfer of the beam from the injector to the primary accelerator is examined. The formulation of this problem is connected with the characteristics of the injector of the TPI 1.5-GeV synchrotron. The horizontal emittance of the beam extracted from the injector must have larger dimensions than the beam emittance in the vertical plane. At the same time the horizontal admittance of the synchrotron must be significantly smaller than the admittance in the vertical plane. This problem was solved by means of an inhomogeneous axial-symmetric magnetic field of the short lens. The studies showed that bending the beam 90° makes it possible to reduce the particle loss during beam injection into the synchrotron chamber. The capture coefficient in the first stage of injection was increased 1.5 to 2 times. (tr-auth)

16592 (KHFTI-72-45, pp 112-114) PULSE MODULATOR FOR A THREE-ELECTRODE ELECTRON SOURCE. Abdukaev, I. Kh.; Gryzlov, A. I.; Borisov, D. G. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). 1972. (In Russian).

The pulse modulator consists of a grid modulator, step-up transformer, and a system for the stabilization of the pulse peak. A block diagram is given. The circuit of the modulator cascade is also given. (JSR)

16593 USE OF THE DIGITAL COMPUTER FOR THE CONTROL OF THE BEAM INJECTION INTO THE CYCLIC ACCELERATOR CHAMBER. Zabrodin, L. D.; Nikitin, V. D.; Pilyudin, V. V.; Solov'en, G. N. pp 5-19 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

The possibility was investigated of constructing an automatic digital computer (Dnepr-I) system for optimizing the beam entry to the vacuum chamber of the cybernetic accelerator. The criterion taken for optimum entry was the value of the amplitude of betatron oscillations. The computer processes the information entering the channels of orbit indication and distributes the corresponding operator recommendations. The algorithm made an experimental correction on the beam entry system of the 1-GeV cybernetic accelerator of the Radio-Technology Institute of the USSR Academy of Sciences. An algorithm was developed for searching initial conditions for injection on an equilibrium orbit. (tr-auth)

16594 DESIGN OF THE INJECTOR SYSTEM OF THE MESON FACTORY COMPLEX. Avramenko, M. I.; Batskikh, G. I.; Golubev, V. P.; Klenov, G. I.; Komar, E. G.; Komarov, V. L.; Kuznetsov, V. S.; Nalivaiko, G. A.; Saksaganskii, G. L.; Solnyshkov, A. I.; Trubnikov, G. I.; Fidel'skaya, R. P.; Tsepakin, S. G. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). pp 261-268; 315-316 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The design characteristics of the injection complex of the meson factory based on a high-current linear accelerator are described. The results of the study are reported in connection with the development of a system for the transport of an intense ion beam. The injector was calculated for the simultaneous injection of 2 beams: protons and negative ions or protons and polarized ions. The system for the bunching of the beam is briefly examined. The calculated parameters for the beam at the injector output are given. (INIS)

Ion Optics and Field Calculations

16595 (JINR-P9-7951) NUMERICAL STUDY OF THE ELECTROMAGNETIC WAVE SCATTERING BY A RING BUNCH OF PARTICLES. I. Calculation of the Scattering Equation Coefficients. Irkegulov, A. Sh.; Urazakov, E. I.; Shvachka, A. B.; Shvachka, O. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The coefficients are calculated for the scattering of electromagnetic waves by a ring bunch of particles, and the analysis of these values is made depending on the physical factors of a wave and a bunch. In some particular cases one succeeds in obtaining a final system of equations for the wave amplitudes. Physical discussion of results is presented. (auth)

16596 (KHFTI-72-45, pp 54-58) SOME PROBLEMS IN THE DEVELOPMENT AND USE OF THE MATHEMATICAL MODEL OF THE 2-GeV LINEAR ELECTRON ACCELERATOR. Artemov, V. I.; Grishaev, I. A.; Dem'yanenko, G. K.; Dovbnya, A. N.; Mocheshnikov, N. I. 1972. (In Russian).

A mathematical simulation of the radial-phase motion of particles in the linear electron accelerator is shown. The mathematical model of the 2-GeV LUZ was formulated on the basis of a specially developed program for the calculation of the radial-phase motion of particles on the M-220 computer. Two simulation regimes are possible: analysis of the behavior of one particle and analysis of the behavior of a group of particles. Data on the improvement of the model during its use are re-

ported. The results of a study on the selection of the regime of the focussing channel in the accelerator are given as an example of the use of the model. (tr-auth)

16597 (KHFTI-72-45, pp 64-66) IMPROVEMENTS IN THE FOCUSING SYSTEM OF THE 2-GeV LINEAR ELECTRON ACCELERATOR. Artemov, V. I.; Dem'yanenko, G. K.; Kovalenko, N. A.; Peev, F. A. 1972. (In Russian).

The improvements made to the focusing system of the 2-GeV linear electron accelerator for the purpose of improving the radial-angular characteristics of the beam are described. The improvements included the fabrication of a "hard" focusing channel in part of the primary accelerating channel and an increase of the precision of the quadrupole lens. Experimental studies made after the modifications showed that they made it possible to reduce the effective emittance of the beam 4 times and improve the form and position stability of the beam. (tr-auth)

16598 (KHFTI-72-45, pp 71-74) SPACIAL DISTORTIONS OF THE ACCELERATING FIELD IN RESONATORS LOADED WITH AN ACCELERATED PARTICLE BEAM. Lomize, L. G.; Filipchikov, L. A. (Radio Technical Inst., Moscow). 1972. (In Russian).

The calculation of the spatial distortions of the accelerating field is based on the use of the equivalent circuit method. This makes it possible to substitute space resonators, excited by the accelerated beam into another type of self-oscillation, with a corresponding parallel LCR circuit excited by an equivalent current. The results showed that the amplitude and phase distortions of the highest oscillation modes are directly proportional to the current intensity and inversely proportional to the electromagnetic energy accumulated in the resonator. The frequency difference between the operating and the highest modes is practically independent of the loss at the junction of the resonator. At beam currents above 200 Ma these distortions can lead to substantial effects on the dynamics of the accelerated particles. (JSR)

16599 (KHFTI-72-45, pp 76-78) MEASUREMENT OF BEAM ENERGY LOSSES IN A TRANSIENT REGIME. Ivanov, G. M.; Makhnenko, L. A.; Gritsenko, V. N. 1972. (In Russian).

The energy loss of the beam was measured at different currents in the transient and stationary regime in the LU-360 electron linear accelerator. The experimental results were compared with values calculated in the one-wave approximation. (JSR)

16600 (KHFTI-72-45, pp 78-80) PROBLEM OF NONSTATIONARY LOADING WITH CURRENT IN A LINEAR ELECTRON ACCELERATOR. Gusarov, V. N.; Shal'nov, A. V. (Moscow Engineering-Physics Inst.). 1972. (In Russian).

The interaction of the electron bunch with the uniform sections of the electron linear accelerator was examined with a consideration of the dispersion effect. The interaction was examined only with the lowest pass band of the iris waveguide. The data obtained was compared with calculations. The irradiation loss during interaction with structures having the geometric dimensions of the section divisions of the 360-MeV accelerator was calculated by the equations derived. (tr-auth)

16601 (KHFTI-72-45, pp 98-99) ION BEAM PHASE VOLUME EFFECT ON THE PIERCE OPTICS GEOMETRY. Meleshkov, S. I.; Revutskii, E. I.; Skoromnyi, G. M.; Meleshkova, Yu. V. 1972. (In Russian).

The results of computer calculation of the geometry of the Pierce electrodes with a consideration of the beam emittance for proton beams are reported. It was shown that for appropriate correction of the Pierce ion-optics system during transition from one value of the emittance to another, the transfer of the electrodes along the axis of the system in agreement with the solution of the proposed equation is sufficient. The possibility of such a movement must be considered during the design of the ion-optics system. (tr-auth)

16602 (KHFTI-72-45, pp 109-111) NONSTATIONARY PROCESS IN A HIGH CURRENT LINEAR ELECTRON ACCELERATOR WITH A BEAM CIRCULATION. Levin, V. M.; Rumyantsev, V. V.; Ryabtsov, A. V.; Smirnov, V. L.; Shchepin, Yu. P. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). 1972. (In Russian).

The nonstationary processes arising in accelerators with a circulating beam of the microtron type were studied. These processes are connected with the loading of the acceleration system by the following beam. They can lead to breakdown of the stable acceleration regime. A method is given for the calculation of the operating characteristics of the accelerator working in a regime of a single acceleration of the particles (without circulation) and in a regime of double acceleration of the particles (with circulation). The results are given for 10 values of the current from 0.1 to 0.4 amp. (JSR)

16603 DETERMINATION OF THE INTRINSIC FIELD AND DENSITY DISTRIBUTION OF A PARTICLE BEAM IN A RESONANCE LINEAR ACCELERATOR BY ANALOG COMPUTER. Baev, V. K.; Solov'ev, L. S. pp 126-136 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

Problems of determining the physics typical of a beam field and the distribution of the charges in the beam by a perturbed accelerating field are discussed. The problem is formulated for a one-dimensional case, when the charges move only parallel to the accelerator axis and interact with the longitudinal electric component of the accelerating and inherent electromagnetic fields. Particle distribution according to velocity is Gaussian. The second-order differential equation obtained, which describes the given problem, was solved on an analog computer with auxiliary equipment consisting of a block of logic elements, controlled by a voltage divider and a feed block. A method is described for passing the limits, and the corresponding algorithm of the solution is given. A block diagram of the solution to the problem and the results of the solution are presented. (tr-auth)

16604 SIMULATION OF THE ELECTRON LINEAR ACCELERATOR ENERGY EQUATION IN A CANONICAL FORM. Chalyi, V. D. pp 105-111 of Primenenie Tsifrovykh i Analogovykh Vychislitel'nykh Mashin v Yadernoi Fizike i Tekhnike. Solov'ev, G. N. (ed.). Moscow; Atomizdat (1971). (In Russian).

A technique is discussed for transferring from a second-degree polynomial in the general form to a canonical form for use on analog computers. A structural diagram is given for modeling the energy equation in canonical form. (tr-auth)

16605 DISTORTION OF ACCELERATING FIELDS IN RESONATORS UNDER BEAM LOADING. Lomize, L. G.; Filipchikov, L. L. Tr. Radiotekh. Inst.; No. 11, 3-18(1972). (In Russian).

The problem of amplitude and phase distortions of the accelerating field is considered in accelerator resonators with an Alvarez structure. These distortions occur as a result of the excitation of higher types of oscillations by the beam. Relations are derived for determining the maximum distortions caused by various spatial inhomogeneities of field and beam amplitude. Numerical estimates are presented which show that at beam currents above 0.2 to 0.3 A the field distortions can attain noticeable size. (SJR)

16606 HIGH FREQUENCY QUADRUPOLE FOCUSING AT AVERAGE ENERGIES IN A PROTON LINEAR ACCELERATOR. Vlasov, A. D. Tr. Radiotekh. Inst.; No. 11, 44-54(1972). (In Russian).

It is shown that it is possible to attain quadrupole focusing by an accelerating field in a proton linear accelerator at energies from 100 MeV to 1 GeV and higher at a current on the order of 50 mA and at a wavelength of 30 cm. An estimate is made of the effect of various factors on focusing of the beam and recommendations are made with respect to selection of the equilibrium phase, length of the lens, and other parameters. The relations for changing the parameters of the focusing system and of the accelerated bundles with an increase in particle energy are examined. (SJR)

16607 CHARACTERISTICS OF REGULATING PROCESSES IN A TWO-CIRCUIT SYSTEM WHILE TAKING INTO ACCOUNT THE EFFECT OF THE BEAM ON THE OSCILLATORY PROCESS. Titov, N. K. Tr. Radiotekh. Inst.; No. 11, 19-32(1972). (In Russian).

It is shown that the characteristics of regulatory processes in this system may be of three types: stable node, stable focus, and saddle. The type of process is determined by the relation between the value of the emf, the equivalent beam, and the circuit parameters. (SJR)

16608 FERRERS POTENTIALS OF AN ELLIPSOID AND OF AN ELLIPTICAL CYLINDER. Muratov, R. Z. Tr. Radiotekh. Inst.; No. 11, 212-218(1972). (In Russian).

For charge distributions having the form of step coordinate functions, the potentials of an ellipsoid and of an elliptical cylinder were found by Ferrers method. The internal and external potentials are written in the same form containing values M_{lms}, which in the case of the internal potential are constants, and have the meaning of generalized demagnetization factors. (SJR)

16609 FINITE CORRECTION OF COHERENT BETATRON BEAM OSCILLATIONS IN CYCLIC ACCELERATORS. Efimov, S. P.; Roginskii, L. A. Tr. Radiotekh. Inst.; No. 11, 65-73(1972). (In Russian).

A finite correction method is considered for dampening free, coherent beam oscillations in an accelerator. It is shown that the minimum quieting time is two periods of particle rotation along the accelerator annulus. An equation is found in explicit form that

attains dampening within this time with minimum energy expenditures. (SJR)

16610 OHMIC LOSSES DURING MOVEMENT OF INTENSIVE ELECTRON RINGS IN A WAVEGUIDE WITH A FINITE WALL CONDUCTIVITY. Voskresenskii, G. V.; Kurdyumov, V. N.; Levin, M. L. Tr. Radiotekh. Inst.; No. 11, 192-201(1972). (In Russian).

Calculations are made on ohmic losses of an electron ring moving in a circular waveguide having a finite wall conductivity. Analytical expressions were obtained for the losses. It is pointed out that the losses are large at low ring velocity. (SJR)

16611 STABILITY OF AXIAL OSCILLATIONS OF AN ELECTRON RING IN THE ABSENCE OF EXTERNAL FOCUSING. Yudin, L. A. Tr. Radiotekh. Inst.; No. 11, 202-208(1972). (In Russian).

Calculations are made on increments of axial oscillations of a relativistic electron ring in the absence of external focusing in free space and in a waveguide without taking into account the energy dispersion in the beam. An estimate is presented for the threshold energy dispersion necessary for suppression of instabilities. (SJR)

16612 MODELING INTENSE BEAMS OF CHARGED PARTICLES HAVING A NON-ZERO PHASE VOLUME IN AN ELECTROLYTIC CELL. Aksenov, V. A.; Ostashov, S. V. Tr. Radiotekh. Inst.; No. 11, 209-211(1972). (In Russian).

A method is proposed for modeling intense proton beams with a previously known emittance in an electrolytic cell having current-carrying elements. (SJR)

16613 LINEARIZED EQUATIONS OF CHARGED PARTICLE MOTION IN AN ACCELERATOR HAVING A COMPLEX, SPACIAL CONFIGURATION OF ELECTRICAL AND MAGNETIC FIELDS. Kalinin, A. A. Tr. Radiotekh. Inst.; No. 11, 81-89(1972). (In Russian).

Linearized equations are obtained for the motion of a charged particle beam in an accelerator with a complex, spacial configuration of electric and magnetic fields, when the equilibrium orbit is a separate phase trajectory of one of the beam particles. Linearization is carried out simultaneously along three coordinates and along all four-momentum components in a system of coordinates connected with a separated phase trajectory. (SJR)

16614 PRODUCTION AND INVESTIGATION OF A GAMMA-RAY QUASISTATIONARY BEAM IN THE ELECTRON LINEAR ACCELERATOR-STORAGE RING SYSTEMS. Adeishvili, P. I.; Bulyak, E. V.; Grishaev, I. A.; Kozin, V. P.; Mocheshnikov, N. I.; Tolstoi, A. E. pp 378-381 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The calculation results and the experimental determination of the characteristics of the quasistationary photon beam produced in a system consisting of a linear accelerator and a storage ring are reported and analyzed. The calculation was made for three systems with energies of 70, 250, and 1700 MeV. Analysis of the calculations show that the predicted characteristics of photon beams can be determined as a function of the specific conditions of the experiment by variation of different parameters. (INIS)

16615 ISOFREQUENCY PERIODIC FOCUSING STRUCTURE WITH MAXIMUM STABILITY REGION. Dymnikov, A. D.; Lenkov, D. I. (Leningrad State Univ.). pp 151-155 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

Antisymmetric periodic focusing structures were examined under the assumption the movement of the particles in two mutually perpendicular planes can be investigated simultaneously. From the analysis made it was concluded that the structures with zero length of free space and with equal lengths of the parts with a magnetic field have the largest stability regions. (INIS)

16616 ULTIMATE INTENSITIES OF SUPERCONDUCTING SYNCHROTRONS AND STORAGE RINGS. Deryugin, G. M.; Mingalev, B. S.; Shukeilo, I. A. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). pp 126-129 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The dependence of the ultimate intensity of proton synchrotrons and storage rings with an energy of the order of a thousand GeV on the intrinsic field of the beam was studied in the case of the use of superconducting magnets with circular apertures. The incoherent shift of the frequency of the betatron oscillations and the distortion of the closed orbits were analyzed. (INIS)

16617 ANALYSIS OF TECHNIQUES FOR BEAM TRANSVERSE INSTABILITY DAMPING IN ELECTRON LINEAR ACCELERATORS. Grishaev, I. A.; Zykov, A. I.; Kramskoi, G. D.; Kurilko, V. I.; Shendrik, V. A. (Physical-Technical Inst., Kharkov). pp 156-161 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

An analysis was made of the results of theoretical and experimental studies of the mechanism of the development of transverse instabilities of the beam in the resonator sections of multisection accelerators. Calculations of the effect of the magnetic focusing on the critical current showed that with increase of the radial focusing (increase of the number of betatron oscillations) the critical current increases. The number of betatron oscillations in the fixed length of the 2-GeV accelerator necessary for double increase of the critical current was calculated as a function of its size. Experimentally it was shown that the increase of the critical current several times in 2-GeV accelerators can be attained by a significant reduction of the noise both in the original part and throughout the accelerator. (INIS)

16618 FORMATION OF A RADIALLY INCREASING MAGNETIC FIELD OF A SUPERCONDUCTING ACCELERATOR. Vodop'yanov, F. A.; Tagintsev, Yu. F. (Radiotechnical Inst., Moscow). pp 211-213 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

A method for the formation of the magnetic field of a superconducting accelerator is described. It is based on the fact that multipole iron-free magnets have fields which vary according to the law $\rho^{n/2-1}$ where ρ is the distance measured from the center of the magnet and n is the number of poles (windings). This law of varying the magnetic field is given in the form of a power series whose coefficients can be determined, for example, by means of the Lagrange interpolation formula. The calculations showed that for the formation of the field of a 1000-GeV synchrotron $B_{orig} \approx 4.2$ kG and $B_{final} \approx 60$ kG) in which the movement of the magnets is 25 cm, the use of multipole magnets up to n = 12 inclusively, guaranteeing $\Delta B/B = 10^{-3}$, is necessary. Formulas are given for the calculation of the magnetic induction of the multipole magnets. (INIS)

16619 SPACE CHARGE EFFECT ON THE PARTICLE AXIAL OSCILLATION FREQUENCY IN AN ISOCHRONOUS CYCLOTRON. Glazov, A. A.; Dzhelepov, V. B.; Dmitrievskii, V. P.; Zamolodchikov, B. I.; Kol'ga, V. V.; Novikov, D. L.; Onishchenko, L. M. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 311-314 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The results of the experimental investigation of the dependence of the frequency of the axial oscillations of the beam on the beam current by excitation of the parametric resonances using the method of modulation of the longitudinal pulse of the accelerated particles with a frequency equal to the doubled frequency of the vertical oscillations are reported. The equation of the axial oscillation was derived with consideration of the space charge force. It was found that the displacement of the oscillation frequency under the influence of space charge is accompanied by the appearance of frequency bands whose size is proportional to the displacement (i.e., the beam current). A comparison of the theoretical and experimental data is made in graphic form. (INIS)

16620 EXPERIMENTS WITH A CLOSED PROTON BEAM IN THE IONIZED RESIDUAL GAS. Dimov, G. I.; Shamovskii, V. G.; Chupriyanov, V. E. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 349-352 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The results of the experimental study of the coherent vertical instabilities of a closed proton beam in a circular path with constant magnetic field and charge-exchange injection of the protons are described. The buildup of the vertical coherent oscillation was identified with instabilities of the hose type caused by the interaction of the circulating proton beam with the secondary electron current. The effect of Landau capture on the stabilization of these instabilities was studied. It is shown that Landau capture leads to a definite stabilization of these instabilities. Other methods for the suppression of instabilities are indicated. (INIS)

16621 SOME PROBLEMS IN INTERACTIONS OF INTENSIVE CHARGED PARTICLE BEAMS WITH ACCELERATING WAVEGUIDES. Gusarov, V. N.; Shal'nov, A. V. (Moscow Engineering Physics Inst.). pp 147-150 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

Theoretical studies on the interaction of intense charged particle beams with accelerating waveguides are described. The charge of the waveguide by the beam current with consideration of the dispersion effect, that is with consideration of the energy loss of the beam in radiation both at frequencies corresponding to the conditions of synchronization of the beam and wave and at frequencies of the pass band of the irised waveguide, is examined.

It was established that the approach used for the study of the charge of the accelerating waveguide by the current is usable for the examination of analog effects in the resonator sector operating in a traveling wave regime. (INIS)

16622 BEAM TRANSVERSE INSTABILITY IN A SINGLE RESONATOR SECTION. Kramskoi, G. D.; Kurilko, V. I.; Shendrik, V. A. pp 143-146 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauko (1973). (In Russian)

The interaction of a beam with the resonator section of a linear electron accelerator was studied. The dependence of the transverse deflection of the beam on the number of bunches, beam current, section diameter, and external forces such as the size of the external accelerating beam was studied. The calculation results are compared with the experimental data obtained on standard sections of the Kharkov accelerator. (INIS)

16623 BEAM EJECTION AND PASSAGE OF INTEGRAL RESONANCES IN A 3.7 GeV KAON FACTORY. Sarkisyan, L. A Tr. Radiotekh. Inst.; No. 11, 74-80(1972). (In Russian).

A method is proposed by which it is possible to exclude the most dangerous integral resonance $Q_r = 2$ in the second stage of a synchrotron kaon factory which is connected with the introduction of a lower field harmonic of index $S > 2\ Q_r$ which is closest to $2\ Q_r$. In order to eject the beam having a finite cyclotron radius it is proposed that an integral resonance be used which is attained by a definite selection of structure periodicity in the magnetic field. (SJR).

16624 STUDY OF THE BEAM CAPTURE ON THE 1 GeV CYBERNETIC ACCELERATOR MODEL. Batskikh, G. T.; Meshcherov, R. A.; Urlin, B. M. (Radiotechnical Inst., Moscow). pp 133-136 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

Calculations and experimental results of the study of the beam capture process in the acceleration regime at the 1-GeV proton accelerator, developed at the Radiotechnical Institute as a model of a small-aperture cybernetic accelerator, are reported. The change in the beam intensity in the circulation process is shown. The causes for the basic intensity losses were determined. A proposal is made to increase the beam intensity by realization of adiabatic capture. (INIS)

16625 INCREASING THE BEAM INTENSITY IN PROTON LINEAR ACCELERATOR. Batalin, V. A. (Inst. of Theoretical and Experimental Physics, Moscow); Kapchinskii, I. M.; Kolomiets, A. A. pp 275-279; 316-317 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

Experiments to increase the beam intensity in the I-2 linear accelerator, the injector for the proton synchrotron of the Institute of Theoretical and Experimental Physics, are described and the calculational-theoretical analysis of this problem is given. The studies showed that in order to increase the intensity of the linear accelerator, reconstruction of the matching channel is necessary. The structure of the improved matching channel in comparison with the original structure is shown. Modernization of the matching channel led to an increase of the beam up to 200 mA with simultaneous increase of the phase density of the beam at the output of the linear accelerator. (INIS)

16626 LATEST RESULTS ON SPACE CHARGE EFFECTS IN PROTON SYNCHROTRONS. Balbekov, V. I. (Inst. of High Energy Physics, Serpukhov, USSR); Zenkevich, P. R. pp 92-100 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The results obtained in the study of the space charge effects in proton synchrotrons, particularly at ultra-relativistic energy, are reported. The instability caused by interaction with electrons, coherent longitudinal instabilities, and modulation of the bunch after a critical energy are examined. It was concluded that the coherent instabilities, independent of their nature, are suppressed by an automatic correction train. The excitation of induced transverse oscillations during Coulomb displacement of the betatron frequency is the most dangerous effect. (INIS)

16627 SMOOTH CHANGE IN THE OUTPUT ENERGY OF THE LINEAR RESONANCE ACCELERATOR-MESON FACTORY. Babushkin, A. V.; Bondarev, B. I.; Solov'ev, L. Yu. (Radiotechnical Inst., Moscow). pp 258-260 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The possibility of a smooth change in the output energy of the 600-MeV proton linear accelerator by transition to a non-resonant acceleration regime was studied by mathematical simulation of the accelerating channel. Two methods for the transfer of the resonators into the non-resonant regime were studied: by change of the amplitude and by change of the phase of the hf field. The results are reported. (INIS)

Storage Rings

16628 (KHFTI-72-45, pp 38-39) BEAM LIFETIME ON A STORAGE RING (AT HIGH INTENSITIES). Grigor'ev, Yu. N.; Kononenko, S. G.; Mazmanishvili, A. S.; Reprintsev, L. V.; Shenderovich, A. M. 1972. (In Russian).

A calculation was made of the beam lifetime in the storage ring of the Physical-Technical Institute during the loss of electrons because of elastic scattering of the electrons on each other in the beam at any ratio of the transverse dimensions of the beam. Results of measurements of the beam lifetime as a function of the storage current are reported. The measured and calculated results are compared. (tr-auth)

16629 (KHFTI-72-45, pp 40-42) LONGITUDINAL MOVEMENT OF LARGE NUMBER OF BUNCHES IN ONE SEPARATRIX OF THE STORAGE RING WHILE THEIR INTERACTION WITH THE RESONATOR. Grishaev, I. A.; Zakutin, V. V.; Kononenko, S. G.; Shenderovich, A. M. 1972. (In Russian).

The results of the computer calculation of the parameters of the longitudinal movement of a large number of bunches in the case of injection into the storage ring of a bunched beam or during the changeover of the bunch from several separatrices into one are presented. On the basis of an analysis of the calculation results it is shown that under given conditions damping of the relative oscillations occurs. Dependence of the non-linear damping has a complex character. The original arrangement of the bunches has a substantial effect on the character of the longitudinal movement. (tr-auth)

16630 (KHFTI-72-45, pp 42-44) EXPERIMENTAL CHARACTERISTICS OF THE QUASICONTINUOUS BREMSSTRAHLUNG BEAM FROM THE INNER TARGET UNDER STORAGE RING VARIABLE OPERATING CONDITIONS. Aleishvili, D. I.; Bulyak, E. V.; Zhivotov, N. D.; Kozin, V. P.; Markov, V. V.; Mocheshnikov, N. I.; Tolstoi, A. E. 1972. (In Russian).

The experimental installation is described, and the results of the measurement of the parameters of the bremsstrahlung beam are reported. NaI(Tl) crystals with a photoelectron multiplier and a thick-walled ionization chamber were used as radiation detectors. RM-I x-ray film was used for the experimental determination of the form and dimensions of the beam. The measurement results are reported and some of them are compared with calculated values. (tr-auth)

16631 (KHFTI-72-45, pp 45-46) ELECTRODYNAMIC INTERACTION EFFECT ON THE ELECTRON MOTION STABILITY IN A STORAGE RING. Bulyak, E. V.; Grigor'ev, Yu. N.; Naugol'nyi, N. N. 1972. (In Russian).

The effect of electrodynamic interactions of relativistic electrons on the frequency and decrements of particle oscillations in the bunch rotating in an axially symmetric magnetic field was examined. This interaction causes radiation energy loss of the oscillation damping in all degrees of freedom. The equations for the movement of electrons with consideration of the force of the electrodynamic interaction were obtained. From these equations it is concluded that electrodynamic interaction leads to a decrease of the frequency of the phase oscillations, a reduction of the decrement of phase oscillation damping, and an increase of the decrement of damping of the radial betatron oscillations. (tr-auth)

16632 (KHFTI-72-45, pp 46-48) STATISTICS OF COUNTS OF THE SYNCHROTRON RADIATION FIELD OF RELATIVISTIC ELECTRONS IN A STORAGE RING. Mazmanishvili, A. S.; Shenderovich, A. M. 1972. (In Russian).

A theoretical study of the statistics of the counting of the radiation field of both single and several electrons rotating in a circular orbit in a magnetic field is described. The case of synchrotron oscillations is taken into consideration. The study is limited by the examination of the most important correlations of the first and second order which can be described by space-time correlators. (tr-auth)

16633 (KHFTI-72-45, pp 50-51) POSSIBILITY OF REALIZING CONTROLLED PHOTON BEAMS AT THE STORAGE RING OF THE KHFTI, AN UKRAINIAN SSR. Adeishvili, D. I.; Bulyak, E. V.; Kozin, V. P.; Tolstoi, A. E. 1972. (In Russian).

A variation of the scheme for forming bremsstrahlung beams from the storage ring is proposed. The characteristics of the forming elements are given. The capacity of the storage ring to create pulsed γ quanta with a constant intensity during the pulse duration is shown. (tr-auth)

16634 (KHFTI-72-45, pp 51-53) INJECTION, STORAGE, AND EXTRACTION OF ELECTRONS AND POSITRONS AT THE FACILITY WITH COLLIDING BEAMS (B-4 VEPP-3). Grishanov, B. I.; Lysenko, A. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). 1972. (In Russian).

Some construction characteristics of the strong focussing electron-positron VEPP-3 3.5-GeV storage ring developed for a secondary beam program are described. The schemes for injection, extraction, and storage of particles in the VEPP-3 are examined. The basic parameters of the extracted beam are given. Beam control is achieved primarily by the input of heteropolar right-angle pulses on pairs of deflecting foils. Pulse forming takes place on cable lengths by means of three-electrode dischargers. (tr-auth)

16635 PHASE EFFECTS OF COLLIDING BEAM INTERACTIONS IN THE STRONG-FOCUSING STORAGE RINGS. Derbenev, Ya. S.; Skrinskii, A. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 386-389 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

It is shown that in storage rings with inhomogeneous focusing under the effect of counter bunches the potential well of the energy oscillation of the particles is distorted down to a loss of stability of the equilibrium phase at sufficiently high currents. The effect depends weakly on the transverse dimension of the counter bunch and the amplitude of the particle oscillations and rapidly increases with increase of their azimuthal modulation. This interaction mechanism leads to coupling of the coherent phase oscillation of the counter bunch. This phenomenon, together with the effect of the change of the synchrotron mass, must be considered during the design of an installation with small values of the β function at the site of the encounter. (INIS)

16636 COLLECTIVE INSTABILITY OF COMPENSATED COLLIDING BEAMS. Derbenev, Ya. S. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 382-385 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

It was shown that the equilibrium state of a system of four beams, with compensated interaction at the point of intersection, is unstable with respect to small multipole (in the general case) excitations disturbing the compensation. The instability has a dynamic resonance character and leads to stratification of the beam during which the compensation is almost eliminated. An evaluation indicated that this phenomenon does not permit a significant gain of emittance in four-beam installations in comparison with the usual storage rings. (INIS)

16637 LONGITUDINAL EFFECTS WHILE STORING ELECTRONS IN THE VEPP-3. Veshcherevich, V. G.; Karliner, M. M.; Kulipanov, G. N.; Sedlyarov, I. K.; Petrov, V. M.; Skrinskii, A. N.; Sheromov, M. A. pp 397-402 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The study of the dynamics of the particles in the longitudinal phase space of the VEPP-3 with two resonators at large beam currents (maximum current = 220 mA) is described. The following effects of the interaction of the beam with the resonators and parasitic modes were examined: distortion of the potential well, displacement of the equilibrium phase, fast damping of the coherent oscillations, coherent instabilities, "non-coherent" expansion of the bunch. The parameters of the resonators and parasitic modes are given. (INIS)

16638 TECHNIQUES FOR MEASURING THE BEAM PARAMETERS IN THE VEPP-3 STORAGE RING. Voblyi, P. D.; Zinin, E. I.; Kulipanov, G. N.; Matveev, Yu. G.; Protopopov, I. Ya.; Sheromov, M. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 390-392 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The methods and apparatus used for the measurement of the beam parameters in the VEPP-3 are described. The measurement of the current was done by registration of the intensity of the synchrotron radiation with a photomultiplier. The transverse dimensions of the beam were measured by dissectors with electromagnetic deflection. The dissectors were also used for the study of the dynamics of the particles in the longitudinal phase space. The scheme for the measurement of the lifetime of the beam and for the measurement of the frequency of the betatron oscillations is described. Control of the beam parameters was done by computers. (INIS)

16639 BEAM SIZE CONTROL IN THE STORAGE RING BY RETUNING THE FOCUSING SYSTEM. Kulipanov, G. N.; Mezentsev, N. A.; Perevedentsev, E. A.; Peral'roizen, M. P.; Protopopov, I. E.; Skrinskii, A. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 324-327 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

A variation of the retuning of the existing magnet system of the linear space of the VEPP-3 storage ring is described. Acceptable conditions for the retuning are derived. The retuning increases the luminosity of the storage ring 8 to 12 times and permits operation without limitation of the phase volume of the accelerator up to energies of 2 to 2.5 GeV. The retuning is done with computers. (INIS)

16640 VEPP-2M ELECTRON–POSITRON COLLIDING BEAM FACILITY OF THE NOVOSIBIRSK INSTITUTE OF NUCLEAR PHYSICS. Budker, G. I.; Balakin, V. E.; Barkov, L.M.; Borovikov, V. N.; Vasserman, I. B.; Zinin, E. L.; Kerliner, M. M.; Kopp, I. A.; Livshits, A. A.; Lysenko, A. P.; Mishnev, S. I.; Sidorov, V. A.; Skrinskii, A. N.; Trakhtenberg, E. M.; Tumaikin, G. M.; Shatunov, Yu. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 318-323 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The construction characteristics and some characteristics of the strong-focusing high-luminosity storage ring VEPP-2M with energy up to 670 MeV for experiments with counter beams are described. The storage ring consists of 8 sections of a magnetic system, four with short and four with long gaps. In the short gaps four quadrupole lens, inflector foils, and electrostatic quadrupoles are placed. In one of the long gaps resonators are placed; the other three gaps are designed for carrying out experiments. Each sector contains one C-shaped rotary magnet with homogeneous field, two quadrupole lens, two sectional lens, and two octupole lens. In the magnets there are windings for correction of the size of the field and in the quadrupole lens, windings for correction of the gradient and placement of the lens axis. The injection system contains a pulse iron-free magnet with 4×6 mm aperture, a pre-collision foil, and two deflector foils. The system was calculated on a beam injection with energy in the range from 100 to 700 MeV. The vacuum chamber of the storage rings is made from stainless steel. The majority of the joints are welded; the site of the welded joints is such that it is possible to repeatedly cut the weld and reweld it. The designed vacuum (without beam) is $\sim 10^{-9}$ torr. The hf system of the storage ring consists of a resonator with a frequency of 200 MHz, an hf generator with a power of 7.5 kW, and a control system. The resonator is of the toroidal type. The observation system for the monitoring the beam behavior is based on the observation of the synchrotron radiation. (INIS)

16641 STORAGE RINGS FOR BUNCHING AND TIME LEVELING THE PARTICLE BEAM ACCELERATED BY THE HIGH CURRENT LINEAR ACCELERATOR-MESON FACTORY. Batskikh, G. I. (Radiotechnical Inst., Moscow); Vasil'ev, A. A.; Meshcherov, R. A.; Murin, B. P.; Stavisskii, Yu. Ya. pp 249-253 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The characteristics and basic parameters of a proton storage ring of high intensity based on charge exchange injection at energies from 0.6 to 1 GeV, permitting both effective time leveling of the intensity and its grouping into short pulses, are described. The characteristics of the circuits of a charge exchange injector and beam extraction are examined. It is shown that this storage ring can be used as a powerful pulsed neutron source of nanosecond duration on the basis of the process of multiple production of neutrons during the interaction of protons at 0.6 to 1 GeV with heavy nuclei. (INIS)

16642 LATEST DEVELOPMENT WITH COLLIDING BEAMS IN CEA. Averill, P.; Hofmann, A.; Little, R.; Mieras, H.; Paterson, I. M.; Strauch, K.; Voss, G. A.; Winick, H. (Harvard Univ., Cambridge, MA). pp 341-348; 409 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The present performance of the CEA colliding beam facility with 2 GeV electron and positron beams, its limitations, and some aspects of the experiment presently underway are described. The positron current which can be accumulated is limited at present by phase instabilities. Several ways to improve the current limits have been explored, in particular a special accelerating cavity operating on the third harmonic has been installed. The lifetime of the stored positron current is considerably reduced through long-range beam-beam interactions. To eliminate the problem a new electrostatic plate separation system is being installed. The maximum luminosity at 2 GeV has been measured to be $3.0 \times 10^{28} cm^{-2} sec^{-1}$. The on-line detector has been used in experiments ensuring good resolution against gas background, machine background, and cosmic-ray background events. It operates on-line with the IBM 370/145 computer. (INIS)

16643 VACUUM SYSTEMS FOR SUPERCONDUCTING STORAGE RINGS. Bittner, J. W.; Halama, H. J. (Brookhaven National Lab., Upton, NY). pp 191-194 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The general description of the vacuum chamber for the proposed intersecting storage accelerator ISA is presented. The vacuum chamber will be thermally insulated from the magnets so that the chamber can be baked out while the magnets are still in their superconducting state. The chamber will have its own cooling system. It will be constructed of 7 cm inside diameter Al or Cu tubing with 1 to 2 mm wall thickness. In order to reach residual gas density of 3×10^6 mol/cm^3, 200 l/s pumps will be used. The considerations that have resulted in the choice of the warm vacuum chamber are given and its advantages are pointed out. (INIS)

16644 MEASURING THE MAGNETIC PARAMETERS OF THE VEPP-3 BY MEANS OF A BEAM. Kulipanov, G. N.; Medvedko, A. S.; Nezentsev, N. A.; Perevedentsev, E. A.; Perel'troizen, M. P.; Protopopov, I. Ya.; Rudnev, G. N.; Skrinskii, A. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 393-396 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

A method for the measurement of the basic characteristics of the magnetic field of the VEPP-3 storage ring by means of an electron beam is described and the results are given. The method of excitation of betatron oscillations by resonance buildup was used for the measurement. The precision of the measurement of the frequency of the betatron oscillations was $\sim 4 \times 10^{-5}$ and was determined by the instability of the frequency because of the pulsation of the beam in the power supply to the lens of the linear gap. The results of the measurement of the dependence of the frequency of the betatron oscillation on the field gradient in the lens of the linear gap and the dependence of the beam dimensions and damping time on the frequency of the V4 voltage potential are shown in graphic form. (INIS)

16645 EXPERIMENTAL STUDY ON COHERENT OSCILLATIONS OF TWO BUNCHES IN ONE SEPARATRIX WHILE INTERACTING WITH THE RESONATOR. Koba, I. I.; Kononenko, S. G.; Lobzov, L. D.; Reprintsev, L. V.; Shenderovich, A. M. pp 140-142 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The results of the experimental study of the damping of two bunches in a separatrix while interacting with passive resonators in the 70-GeV electron storage ring are reported. Oscillographs of the amplitude of the 4th harmonic of the current were used to study the process of bunch damping. The effect of the presence of the resonator on the value of the 4th harmonic is shown. The results obtained confirm the assumption on the presence of damping of the relative oscillation of two bunches in one separatrix during their interaction with the resonator. (INIS)

16646 1 GeV ELECTRON STORAGE RING PROJECT FOR SYNCHROTRON RADIATION GENERATION. Kapitsa, S. P.; Duganskii, L. B.; Zykin, L. M. (Inst. of Problems in Physics, Moscow). pp 82-84 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The construction characteristics of the magnet system, injection system, hf system, and vacuum system of the planned 1-GeV electron storage ring, designed as a source of synchrotron radiation, are described. The basic characteristics and general plan of the storage ring are reported. (INIS)

16647 MEASUREMENT OF BEAM POLARIZATION IN THE ORSAY COLLIDING BEAM RING A.C.O. Duff, J.; Marin, P. C.; Masnou, J. L.; Sommer, M. (Institut National de Physique Nucleaire et de Physique des Particules, Paris). pp 371-377 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

Radiative polarization of a positron beam in ACO has been investigated in various experimental conditions of energy, wave numbers and intensity of the counter rotating electron beam. The variation of the final state of polarization allows one to point out the importance of depolarizing resonances, either with one beam or two beams in interaction. The gradual buildup of the polarization of electron or positron beams rotating in an homogeneous magnetic field has been predicted by Sokolov and Ternov. These authors have shown that, in synchrotron light emission, the spin-flip radiative transition depends on the spin alignment with the magnetic field. They predict an exponential increase of the polarization up to a maximum of 92.4%, a γ^{-5} law for the time constant and a polarization parallel (positrons) or antiparallel (electrons) to the magnetic field. (auth)

16648 BEAM CURRENT LIMITATIONS IN THE ISR. Keil, E. (CERN, Geneva). pp 328-340 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The results of the investigations aimed at finding techniques for reliably accumulating in the ISR high-density beams with currents of about 10A and for keeping these beams circulating with small decay rates for long periods of time required for colliding-beam physics runs are presented. The process of shaping the injected beam has been considered and the progress achieved in the beam luminosity is stated. The longitudinal and the transverse beam instabilities are analyzed and the results are shown. (INIS)

16649 ZGS SUPERCONDUCTING STRETCHER RING. Martin, R. L. (Argonne National Lab., IL). pp 217-221; 233 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The specific features of the superconducting storage ring (SSR), proposed by the Argonne National Laboratory are briefly discussed. The main design parameters are given. The advantages of such a ring (a factor of 2 in average beam intensity and 5 in duty cycle of the useful beam) are discussed. (INIS)

16650 SPEAR: PRESENT STATUS AND IMPROVEMENT PROGRAM. Richer, B. (Stanford Univ., CA). pp 358-366; 409 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

Initial operating experience with the SLAC electron-positron storage ring SPEAR is described. A single-beam coherent instability, which can be suppressed either by control of the ring chromaticity or by feedback, has been observed. A second single-beam coherent instability has been observed at currents around 50 mA and is not yet understood. Current-dependent bunch lengthening and widening have been observed, and experiments indicate that these phenomena may be associated with an increase in the energy spread of the beam. A luminosity of 2×10^{30} cm^{-2} sec^{-1} has been achieved and two-beam interaction effects are described. Procedures to increase the luminosity to the design value of 10^{32} cm^{-2} sec^{-1} at 2 GeV are discussed. Plans to increase the maximum beam energy of SPEAR to 4.5 GeV are described. (auth)

16651 TANTALUS 2: AN ELECTRON STORAGE RING FOR VACUUM ULTRAVIOLET RESEARCH. Rowe, E. M. (Univ. of Wisconsin, Madison). pp 25-30; 91 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

Specific design features of the 1.76-GeV electron storage ring are described and the main parameters are presented. The "inside out" design of the magnet system has been chosen to simplify the removal of sections of the vacuum chamber for modification or repair and to reduce the radiation escaping from the machine. In the vacuum chamber, extruded aluminum sections will be used. Internal sputter ion pumps will be used to offset the increased outgassing loads expected in operation. Calculations show that beam currents of over 50 mA will be achieved. The operating frequency of the accelerating system will be 33 MHz. The accelerating cavity will have a mechanical tuning system of sufficient speed to correct for thermal effects and sufficient range to compensate for detuning effects of the beam itself. Radiation problems are discussed and practical formulas for the important characteristics of the synchrotron radiation are given. The plan view of the storage ring is shown. (INIS)

16652 INFORMATION ON COLLIDING BEAM EXPERIMENTS AT DESY. Steffen, K. pp 403-409 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

Some changes in the DORIS storage ring that have evolved since 1969 are briefly described, the most important of them referring to the rf system and the bending magnet vacuum chambers. The instrumentation for the experiments on the storage ring is briefly described and the arrangement of counters is shown schematically. (INIS)

16653 COLLIDING BEAM EXPERIMENTS AT FRASCATI. Pellegrini, C. (CNEN, Frascati, Italy). pp 353-357 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The operation of the 1.5-GeV electron-positron storage ring, Adone, is described and a short summary of the high-energy physics experiments is given. The dependence of luminosity on energy in the energy range from 900 to 1500 MeV is analyzed and the experiments to improve the luminosity by changing the magnetic structure of the ring have been made. The modification program for the machine is briefly discussed. (INIS)

16654 ISABELLA: A 200 GeV COLLIDING BEAM SYSTEM FOR PROTONS. Courant, E. D. (Brookhaven National Lab.,

Upton, NY). pp 367-370 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

A design study is under way at Brookhaven National Laboratory, aimed at the construction of a pair of intersecting storage accelerators producing proton-proton collisions at 200 GeV. Protons are to be injected from the 30 GeV AGS into a pair of rings made with superconducting magnets, accumulated to a circulating current of 15 amperes, slowly accelerated to 200 GeV, and made to collide in specially designed interaction regions. Luminosities of the order of 10^{33} cm^{-2} sec^{-1} appear attainable. Options to be explored later include addition of an electron ring for e-p collision, acceleration of deuterons, and possibly of antiprotons. (auth)

16655 EXPERIENCE GAINED IN THE OPERATION OF THE ISR VACUUM SYSTEM. Fischer, E. (CERN, Geneva). pp 101-106 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The problem of raising the proton current in the ISR to its design value of 20 A is considered. The obstacle which prevents one from reaching this is the beam induced pressure that rises inside the vacuum chamber while accumulating protons to high intensities. The behavior of the pressure in the vacuum chamber in the presence of high intensity proton beams is analyzed. The mechanism of a pressure rise is explained. The gas desorption factor is established to be the main parameter to determine the pressure increase. The strategy in preventing pressure increases is discussed and the results of its implementation are presented. (INIS)

Experimental Facilities

Refer also to abstracts 15852, 16102, and 17356.

16656 (ANL-8080, pp 14.1-14.2) INTENSE NEUTRON FLUXES FROM NUCLEAR CASCADES WITH HIGH ENERGY BEAMS. Carpenter, J. M. (Univ. of Michigan, Ann Arbor). 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

The ZING intense neutron source at the Argonne ZGS is briefly described. The ZING facility will use proton pulses from the proposed 500-MeV proton booster synchrotron which will serve as an injector for the ZGS. (WHK)

16657 (KHFTI-72-45, pp 24-25) FACILITY FOR THE STUDY ON PHOTOPRODUCTION OF CHARGED PIONS ON NUCLEI. Lapin, N. I.; Nikiforov, V. I.; Pugachev, G. D.; Shramenko, B. I. 1972. (In Russian).

The construction characteristics and the basic parameters of an installation for the study of the photoproduction of charged pions on nuclei are described. The installation was developed with consideration of the possibility of rapid replacement of targets without disturbance of the vacuum and precise and rapid adjustment and setting of the photoemulsion camera. The charged pion yield was measured. The total correction to decay in flight and to the interaction with nuclei of the photoemulsion is given. The correction to the solid angle was calculated. Systematic errors in measurement were no more than ±5%. The experiments showed that the results obtained agree well with the data of other authors. (tr-auth)

16658 (KHFTI-72-45, pp 104-106) THREE-MAGNET DEBUNCHER OF THE RELATIVISTIC ELECTRON BEAM. Ryabtsov, A. V. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). 1972. (In Russian).

The properties of a system for the monochromatization of a relativistic electron beam are examined. The system consists of three sector magnets with homogeneous fields which cause beam bending. A numerical example is given of the calculation of the beam debuncher. (tr-auth)

16659 (LA-5618-MS) SLIT SCATTERING IN THE EPICS BEAM LINE. Enselin, N.; Thiessen, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

A Monte Carlo calculation of the interaction of charged particles with collimating slits was used to simulate the EPICS channel and spectrometer. The program was applied to the design of collimating jaws for the channel and to the selection of event rejection tests for the spectrometer. It was possible to predict the expected backgrounds of muons, protons, and slit-scattered pions. (auth)

16660 (LA-UR-74-980) LOS ALAMOS Q3D PROGRAM. Flynn, E. R.; Orbesen, S.; Sherman, J.; Stein, N.; Woods, R. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 18p. (CONF-740650-1). Dep. NTIS $4.00.

From meeting on Q3D's; Upton, New York, USA (7 Jun 1974).

The installation and performance of the Q3D 90 cm Type II spectrometer at the LAMPF linac is described. Also, the development of helix proportional counters is discussed. (WHK)

16661 (UCID-16523) INJECTOR SYSTEM FOR THE 14 MeV HIGH INTENSITY NEUTRON FACILITY. Beal, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1974. Contract W-7405-eng-48. 64p. Dep. NTIS $6.25.

The conceptual layout of the Cockcroft–Walton accelerator for acceleration of deuterons in the 400 to 500 keV range for a new 14-MeV high-intensity neutron facility is described. The ion source will be a von Ardenne duoplasmatron, and the accelerating column will be designed for a total beam current of up to 200 mA. The equipment is housed inside a Faraday cage to shield the equipment from stray electrostatic and rf fields. Beam optics, the cooling system, the vacuum system, and data acquisition and control system are described. (WHK)

16662 DEVELOPMENT AND EVALUATION OF FACILITIES FOR THE EFFICIENT PRODUCTION OF COMPOUNDS LABELED WITH CARBON-11 AND OXYGEN-15 AT THE WASHINGTON UNIVERSITY MEDICAL CYCLOTRON. Wieland, B. W. Columbus, OH; Ohio State Univ. (1973). 170p. University Microfilms Order No. 74-11,203.

Thesis (Ph. D.).

Target and labeling systems for the efficient production of compounds labeled with 20-minute ^{11}C and 2-minute ^{15}O have been developed and implemented in support of an interdisciplinary team of investigators conducting in vivo studies of regional cerebral metabolism and hemodynamics in patients and experimental animals. Modes of production meet requirements for high activity, radiochemical purity, reliability, safety, and the rapid delivery of sequences of radiotracers such as ^{11}C-glucose and blood labeled with ^{15}O-hemoglobin, $C^{15}O$-hemoglobin, and ^{15}O-water. A multi-purpose tandem target assembly permits rapid remote switching between different solid and gas targets bombarded by the 6.2 MeV deuteron beam of the Washington University Medical Cyclotron. A B_2O_3 target for the $^{10}B(d,n)^{11}C$ reaction is mounted on a retractable rod inserted in the path of the deuterons coming through a beam window. Withdrawing this target uncovers a second window, and evacuating the space in between allows beam passage to a gas target for the $^{14}N(d,n)^{15}O$ reaction. (Diss. Abstr. Int., B)

16663 DEVELOPMENT OF MEDICAL CYCLOTRON. Watanabe, N. (Tokyo Univ.). Nippon No Kagaku To Gijutsu; 14: No. 2, 46-52(Feb 1973). (In Japanese).

The construction of a small-sized AVF cyclotron for medical treatment in the Medical Research Institute of the University of Tokyo was approved. The fast neutron beam of the cyclotron has different biological effects from the radiations of low linear energy transfer such as x rays, gamma rays, electron beams, and so on. In case of selecting the cyclotron, the physical conditions of radiation dose rate (rad/minute) and damping characteristics must be satisfied. When the damping characteristic in the living body is desired to be 50%/10cm, the energy of deuterons, which are accelerated to bombard beryllium to emit fast neutrons, requires at least 30 MeV. If the damping characteristic is lowered to 50%/8.3 to 8.6cm, the necessary energy of deuterons may be 15 to 16 MeV. The radiation treatment must be operated according to the program which is prepared by a statistical analysis method and on the basis of the careful accumulation of vast data on radiation treatment. (JA)

16664 STRUCTURAL ANALYSIS OF TRANSIENT PHENOMENA BY TIME OF FLIGHT OF NEUTRONS WITH LINAC. II. High Voltage Pulse Generator Synchronized to LINAC. Muto, M.; Niimura, N. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 95-97(Dec 1972). (In Japanese).

A pulse forming network circuit or a hard tube circuit is known as high voltage pulse generator, but can hardly generate pulses of about 35 msec pulse width. In order to realize the pulse sequence, a dc-dc converter was employed, and its ON-OFF operation was utilized for high voltage pulse sequence generation. This generating equipment is composed of a circuit which generates the high voltage pulse sequence synchronized to LINAC, and a circuit which distributes signals from BF_3 counters to a time analyzer to four lines which in turn impress a positive voltage to samples. The pulse generator offers rectangular pulses of 9 kHz triggered by a gate signal from a signal distribution logic synchronized to a LINAC trigger. The maximum output voltage of the dc-dc converter reaches 6 kV. The fourth LINAC trigger pulse stops the pulse generator, and at the same time triggers a thyratron (1G35p) which discharges the residual charge of a condenser. The above-mentioned cycle constructs the pulse sequence with 6 kV of maximum voltage amplitude, 2 msec of rise time and 35 msec of the

pulse width. The pulse generator by this method has inevitably high output impedance, therefore leakage current from the equipment must be prevented as far as possible. On the basis of the test results of this pulse generator, the second pulser is now being designed. (JA)

16665 SYNCHROTRON RADIATION: A SOURCE FOR SPECTROSCOPY AND STRUCTURAL ANALYSIS IN THE EXTREME ULTRAVIOLET AND SOFT X-RAY REGION. Haensel, R. pp 17-24 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

A review is given on the experiments in spectroscopy and structural analysis in the extreme ultraviolet and soft x-ray region using synchrotron radiation. Some main parameters of the accelerators and storage rings used as synchrotron radiation sources are presented. The advantages of storage rings which are constructed exclusively as synchrotron radiation sources are pointed out. (INIS)

16666 BIOMEDICAL COMPLEX ON THE JINR HIGH FLUX SYNCHROCYCLOTRON. Abazov, V. M.; Dzhelepov, V. P.; Kuz'min, E. S.; Molokanov, A. G.; Reshetnikov, G. P.; Savchenko, O. V.; Stekol'nikov, V. P.; Cherevatenko, E. P. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 85-88 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The channels for forming and transporting the proton beam with energy up to 200 MeV, produced at the JINR synchrocyclotron for radiation therapy of tumor patients are briefly described. The channels for producing different beams (including therapeutic) at the synchrocyclotron are shown. The intensity of the π^- beam is $\sim 10^9$ sec^{-1}. The general scheme for the placement of dosimetric, positioning, and auxiliary apparatus is given. (INIS)

16667 PROTON LINEAR ACCELERATOR: MESON FACTORY DESIGN. Murin, B. P. (Radiotechnical Inst., Moscow). pp 234-248; 314-315 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The basic characteristics of a 600-MeV linear proton accelerator with an average current of 0.5 mA, developed as the basis of an accelerating complex or meson factory, are described. It is proposed to accelerate negative hydrogen ions simultaneously with the protons. For improvement of the reliability of the experimental work a storage ring was installed at the accelerator outlet. The complex developed is a combination of a linear proton accelerator (and negative hydrogen ions) with a comparatively small value of the duty cycle and a storage ring using overload injection of the hydrogen ions and working in a regime of slow extraction of the proton beam. The characteristics of the dynamics of the particles, the accelerating system consisting of five resonations with drift tubes and stabilizing coupling rods, hf power supply system, and a system of the autocontrol of the accelerator are described. The characteristics of the beam extraction from the storage ring are briefly examined, and the basic parameters of the storage ring-expander are given. (INIS)

16668 STATUS REPORT ON THE SIN MESON FACILITY. Blaser, J. P.; Gerber, H. J.; Schryber, U.; Willax, H. A. pp 305-309; 317 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The meson factory being constructed at the Swiss Institute for Nuclear Research is described. A short description of the two-stage proton accelerator is given. The injector cyclotron with 2.5 m pole diameter, 4 spiral sectors and a single dee acceleration system has a variable magnetic field and will operate at 50 MHz which is the 3rd harmonic of the cyclotron revolution frequency. In this mode of operation it is designed to deliver a 100 mA proton beam of 72 MeV with an energy spread of less than 0.3% and emittance of less than 30 mm mrad. The ring cyclotron has 8 "C"-magnets. The pole field increases radially from 15 to 20.8 kG for a final energy of 590 MeV with a main excitation of 148,000 amp-turns. 18 sets of 400 amp-turn pole face windings in each second magnet provide the necessary field corrections. In the other magnets, only injection and extraction radii will be controlled by trim coils. 4 rf cavities resonating on a TE_{11}-mode provide a voltage greater than 500 kV at 50 MHz. They are excited by individual 250 kw rf power amplifiers. The secondary beams will be produced on external targets of Cu and Be. Characteristics of the F-beams are given. First tests of the ring cyclotron with beam are expected towards the end of 1973. (INIS)

16669 SYNCHROTRON RADIATION AS AN INSTRUMENT FOR STUDIES. Kapitsa, S. P. (Inst. of Problems in Physics, Moscow). pp 11-16 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The characteristics and possibilities of the application of synchrotron radiation, particularly the part of its spectrum from 10 eV to 10 keV, to chemistry, solid-state physics, and astronomy are examined. Synchrotron radiation is essentially a particular form of the magnetic-bremsstrahlung radiation which arises during centripetal acceleration of fast electrons in a magnetic field. The assumption is based on the necessity of constructing special sources of synchrotron radiation on which electron storage rings can be based. The characteristics of some existing synchrotrons are reported. (INIS)

16670 CLINICAL COMPLEX USING THE PROTON BEAM FROM THE ITEF SYNCHROTRON. Gol'din, L. L.; Kleinbok, Ya. L.; Lomanov, M. F.; Obosovskii, K. K.; Khoroshkov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). pp 89-91 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

Tests on the use of the proton beam extracted from the ITEP synchrotron for the radiation therapy of oncological patients are briefly described. It was noted that variation of the proton energy (70, 100, 130, 155, and 200 MeV) expands the possibilities of using the proton beam for tumors at different locations. The planned clinical complex using the extracted proton beam would consist of 4 location-specialized treatment rooms and rooms for carrying out physico-technical and biological studies. The complex offers the possibility of conducting more than 100 radiation treatments in 8 hrs. (INIS)

16671 CYCLIC MESON FACTORIES. Short Review and Development Prospects. Dzhelepov, V. P.; Dmitrievskii, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 280-287 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

The characteristics and parameters of the cyclic meson factory are described. The meson factory was compared with linear and collective accelerators. It was noted that the average beam intensity in the meson factory of the circulating type exceeds the pulse intensity of linear accelerators and is limited at the present only by the limited power of the high-frequency accelerating system. The problem of the extraction of the accelerated particles from the chamber appears to be the basic problem in the development of cyclic meson factories. (INIS)

16672 PRODUCTION OF MEDICAL RADIOISOTOPES AT THE PRETORIA CYCLOTRON. Steyn, J. (National Physical Research Lab., Pretoria). pp 299-310 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The role of accelerators as facilities for radioisotope production and the exclusive features of some of the accelerator-produced isotopes are discussed. The cyclotron of the National Physical Research Laboratory as production facility is briefly described. It was decided initially to concentrate on a number of relatively long-lived isotopes for which a demand existed overseas and which would be exported in bulk. Six carrier-free isotopes are now in regular production for the export market. The production of short-lived isotopes for local use was initiated in 1970. At present, ^{18}F, ^{52}Fe, ^{67}Ga, ^{123}I, ^{203}Pb and ^{211}At are in regular production, mainly for use in the life sciences and more specifically for radiodiagnostic applications in South African hospitals. Some of the problems involved with production and delivery of these nuclides are pointed out. Development in the following related fields, stimulated by the production program, is discussed: the chemical processing of carrier-free radioactive isotopes, the determination in absolute measure of the disintegration rates of accelerator isotopes, the measurement of excitation functions and yields, and the manufacture of efficient targets. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 15544–15546, 15548–15551, 15554, 15555, 15566, 15641–15643, 15652–15661, 15664, 15667–15671, 15674–15679, 15683, 17093–17096, 17105, 17107–17113, 17115–17119, 17121, 17188–17190, 17198, and 17371.

16673 (CONF-730804-P3) 13th INTERNATIONAL COSMIC RAY CONFERENCE, DENVER, COLORADO, 17–30 AUGUST 1973. Volume 3. NM and HE Sessions. (Denver Univ., Colo. (USA)). 1973. 755p. Dep. NTIS $40.75.

Separate abstracts are prepared for 101 of the 102 papers presented. One paper previously appeared in NSA as 26: 22330. (CES)

For abstracts of individual papers see: 15652, 16674–16742, 17093–17096, 17105–17120, 17187–17190, 17198, 17208, and 17371–17375.

16674 (CONF-730804-P3, pp 1709-1714) ACCURATE MEASUREMENT OF MUON INTENSITY AT TWO DEPTHS UNDERGROUND. Wright, A. G. (Polytechnic of North London, Hollowayndo). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Underground muon intensity measurements were made at depths of 71.6 and 460 hg cm^{-2}, using a scintillation stack of cubical geometry, where the vertical intensities were found to be $(5.6 \pm 0.13) \times 10^{-4}$ and $(1.02 \pm 0.03) \times 10^{-5}$ cm^{-2} s^{-1} sr^{-1} respectively. It is shown that this type of apparatus is particularly suitable for absolute measurements because the aperture can be determined precisely and corrections for both showers and spurious events can be made with confidence. A survey based mainly on more recent intensity measurements indicates that any remaining discrepancies between underground and underwater results may well be insignificant. (auth)

16675 (CONF-730804-P3, pp 1715-1720) DIRECTIONAL MUON INTENSITY UNDERGROUND FROM 0 TO 80° AT 700 TO 5000 hg/cm^2. Sheldon, W. R. (Univ. of Houston, TX); Bazer-Bachi, A. R.; Benbrook, J. R.; Vedrenne, G.; Dunet, C.; Duller, N. M.; Cantrell, W. G. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Results from the French–U. S. underground experiment in the Mont Blanc tunnel (47.8°N, 4.5°E, 1300m) are presented. Data were obtained over a range of 700 to 5000 hg/cm^2 in depth and 0° to 80° in zenith angle. The results presented here are based on 60,000 muon events measured between August 1968 and April 1972; the experiment is still in progress. Two features appear to be of interest. First, the vertical range spectrum is in relatively good agreement with that of other workers up to 2500 hg/cm^2, but falls off more rapidly at greater depths. Second, the zenith angle distribution does not exhibit a "sec θ" dependence as predicted by a conventional (π-K) model. Rather, the zenithal distribution decreases with zenith angle near the vertical, with a minimum near 30° about 10% below the vertical intensity; at angles > 50°, the zenithal distribution appears to be reasonably close to that expected for a π-K source. No theoretical explanations are offered, but a few comments are made. (auth)

16676 (CONF-730804-P3, pp 1722-1727) ZENITH ANGLE AND DEPTH DEPENDENCE OF COSMIC-RAY MUONS. Bergeson, H. E.; Carlson, G. W.; Keuffel, J. W.; Morrison, J. L. (Univ. of Utah, Salt Lake City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The Utah experiment on angular distribution of TeV cosmic ray muons was repeated with improvements in the detector and in the analysis. The results agree with expectation based on pion and kaon parentage of the muons. A muon intensity vs. depth curve of high statistical accuracy is presented. (auth)

16677 (CONF-730804-P3, pp 1729-1732) RADIOCHEMICAL MEASUREMENTS OF MUONS UNDERGROUND. Fireman, E. L.; Steinbrunn, F. (Smithsonian Astrophysical Observatory, Cambridge, MA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A production rate of 4.2 ± 0.5 ^{37}Ar atoms day^{-1} kg^{-1} of ^{39}K was measured at 4.0×10^3 g cm^{-2} depth under the Boston Harbor by collecting argon from 18 kg of potassium acetate powder. A production rate of 0.35 ± 0.20 ^{37}Ar atoms day^{-1} kg^{-1} of ^{39}K was measured at 8.3×10^4 g cm^{-2} depth in the Hoosac Railroad Tunnel in western Massachusetts by sweeping argon from 90 kg of potassium acetate powder. These production rates are attributed to negative muon captures and the electromagnetic interaction of fast muons. The high sensitivity of the ^{37}Ar radiochemical method permits the use of simple apparatus to measure muons at great depths. (auth)

16678 (CONF-730804-P3, pp 1733-1738) MEASUREMENT OF ABSOLUTE COSMIC-RAY MUON INTENSITIES UNDERGROUND AT LARGE ZENITH ANGLES. Cantrell, W. G. (Texas A and M Univ., College Station); Duller, N. M.; Green, P. J.; Smith, O. L.; Kasten, R. R.; Bazer-Bachi, A. R.; Sheldon, W. R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A Geiger-counter telescope has been used to make absolute measurements of cosmic ray muon intensities at slant depths ranging from 80 to 360 hg/cm^2 and at zenith angles from 71° to 86°. The telescope was operated in an underground limestone quarry with the telescope axis directed toward a smooth steep bluff which bounds the quarry. The absorber geometry is ideal for large zenith angle measurements because of the small variation of slant depth with zenith angle. Measurements at a wide range of slant depths were accomplished by moving the apparatus to different sites in the mine. The experimental results are compared with theoretical calculations based on a model of production and propagation of muons in the atmosphere. (auth)

16679 (CONF-730804-P3, pp 1740-1745) RANGE OF MUONS IN ROCKS. Adair, R. K.; Kasha, H. (Yale Univ., New Haven). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The passage of muons of definite energy through standard rock is followed through Monte Carlo techniques using energy loss expressions slightly modified from the expressions developed by Kobayakawa. No mathematical or physical approximations of any consequence are used in the diffusion calculations and the only uncertainties in the results are then derived from the limitations of knowledge of the characteristic energy losses and from the statistical limitations which result from the decision to follow 1000 muons for each of 8 different incident energies ranging from 178 GeV to 10,000 GeV. The distribution in ranges of muons with given incident energies is calculated and the distribution of initial muon energies for all muons which pass a given thickness of rock is calculated. For the latter calculation, conventional intensity vs energy relations are used. (auth)

16680 (CONF-730804-P3, pp 1748-1753) HORIZONTAL SEA-LEVEL MUON SPECTRA UP TO 1.5 TeV. Allkofer, O. C.; Carstensen, K.; Dau, W. D.; Faehnders, E.; Sobania, R. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The muon momentum spectrum at 83° zenith angle has been measured with the Kiel cosmic ray spectrograph in the momentum range 10–1500 GeV/c. The presented analysis was performed with 22000 particles from the angular range 78°–88°. The horizontal integral spectrum crosses over the vertical Kiel spectrum at 95 GeV/c. The accuracy of the measurement was checked by repeated analysis of the events the calculated momentum of which exceeded 200 GeV/c. To investigate fine structure behavior the fluxes in 2.5° bins have been analyzed. (auth)

16681 (CONF-730804-P3, pp 1754-1763) ABSOLUTE MUON SPECTRUM IN THE RANGE 3.5-700 GeV/c IN THE NEAR VERTICAL DIRECTION. Ayre, C. A.; Baxendale, J. M.; Daniel, B. J.; Hume, C. J.; Thompson, M. G.; Whalley, M. R.; Wolfendale, A. W. (Univ. of Durham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The absolute spectrum based upon 10^6 particles recorded traversing the spectrograph MARS above 20 GeV/c is consistent with a new integral measurement at 7.0 GeV/c. The absolute

spectrum is 10% lower than the "best fit" line to the recent absolute spectra of Allkofer et al. It is suggested that the exponent of the pion production spectrum decreases slightly with momentum, being 2.65 ± 0.01 for 20 < P < 70 GeV/c and 2.55 ± 0.03 for 70 < P < 700 GeV/c. (auth)

16682 (CONF-730804-P3, pp 1764-1770) SEA-LEVEL MUON SPECTRA AND CHARGE RATIOS FROM THE UCSD COSMIC-RAY SPECTROMETER. Burnett, T. H.; Masek, G. E.; Maung, T.; Miller, E. S.; Ruderman, H.; Vernon, W. (Univ. of California, San Diego). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The muon energy spectrum and charge ratios at sea level have been measured by the UCSD cosmic ray spectrometer operating at eight angles from vertical to 82°. A method is presented to combine the data at all angles to determine the spectral index γ and the vertical spectrum. The result is $\gamma = 2.715 \pm 0.015$. The charge ratio μ^+/μ^- is also shown, and its value for E cos θ > 25 GeV is 1.244 ± 0.012. (auth)

16683 (CONF-730804-P3, pp 1771-1780) SPECTROGRAPH MEASUREMENT OF THE MOMENTUM SPECTRA OF ATMOSPHERIC MUONS IN THE TeV RANGE AT DIFFERENT ZENITH ANGLES. Leipuner, L. (Brookhaven National Lab., Upton, NY); Larsen, R.; Smith, L.; Adair, R.; Higgs, B.; Kasha, H.; Kellogg, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A large variable-inclination magnetic spectrometer was constructed to measure the spectra of cosmic ray muons at different zenith angles in the TeV energy range. Scintillation counters and optical spark chambers were used to detect the particles, and a solid iron magnet provided momentum analysis. Film generated on the spectrometer was measured on a computer-controlled automatic film reader. The resolution of the spectrometer was measured, and its maximum detectable momentum found to be in excess of 2.5 TeV/c (defined in term of standard error). Measurements of the muon momentum spectra at zenith angles of 30° and 75°, and of their charge ratio were obtained. (auth)

16684 (CONF-730804-P3, pp 1781-1787) ENERGY SPECTRUM OF MUONS ABOVE 3.10^{11} eV IN THE NEAR VERTICLE DIRECTION. Ng, L. K.; Wdowczyk, J.; Wolfendale, A. W. (Univ. of Durham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An examination is made of a variety of experimental data relating to muons and an estimate is made of the energy spectrum of near vertical muons at energies above $\sim 3.10^{11}$ eV. It is concluded that the best fit muon spectrum corresponds to a differential pion production spectrum with exponent -2.69 ± 0.03 i.e., that the exponent of the integral muon spectrum tends to this value above $\sim 10^{12}$ eV. (auth)

16685 (CONF-730804-P3, pp 1788-1796) HIGH-ENERGY MUON GENERATION IN COSMIC RAYS. Amineva, T. P.; Ivanenko, I. P.; Ivanova, M. A. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An x-ray-emulsion chamber installation for detection of bremsstrahlung photons produced by muons in lead has made it possible to obtain: (1) zenith angular distribution of ≥ 2 Tev muons. The obtained distribution agrees with calculations made on the assumption that the muons are produced in the decays of pions or pions mixed with 20% of kaons; (2) the (2 to 20) Tev muon energy spectra within the entire range of zenith angles. Up to ~ 8 Tev the spectra agree with the assumption that the muons are generated in the decays of pions and kaons displaying a power form of their spectrum with the same exponent as the primary nucleon spectrum. (auth)

16686 (CONF-730804-P3, pp 1797-1802) ENERGY SPECTRUM OF COSMIC MUONS AT LARGE ZENITH ANGLES AND MUON GENERATION AT ENERGIES 10^{12} eV. Kokoulin, R. P.; Pavlov, A. A.; Petrukhin, A. A.; Shestakov, V. V. (Physical Engineering Inst., Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The energy spectrum and the angular distribution of the cascade showers initiated by cosmic muons were measured in the region of 0.2 to 3.0 TeV at large zenith angles (60° to 90°). There are no anomalies in their behavior. It is shown that neither energy spectrum nor the near vertical angular distribution gives the possibility of the simultaneous determination of K/π ratio and the power index of the generation spectrum γ. The two-dimensional distribution is required for this purpose. The analysis of such experimental distribution gives the following result: $\alpha_K = K/(\pi + K) = 0.26 \pm 0.15$ and $\gamma = 1.71 \pm 0.07$. (auth)

16687 (CONF-730804-P3, pp 1803-1808) INVESTIGATION OF CASCADES, PRODUCED BY HIGH ENERGY MUONS. Erlykin, A. D.; Kulichenko, A. K.; Machavariani, S. K.; Nikolskii, S. I. (Lebedev Physical Inst., Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Final results on energy spectrum, angular distribution and shape of cascades, produced by high energy muons in Tien-Shan ionization calorimeter are presented. Results of two additional experiments carried out to clear up the nature of cascades in TeV-region are presented too. Discrepancy between energy spectra measured by ionization chambers and x-ray films is explained via the existence of anormal muon interaction which produces electromagnetic cascades with wide angular distribution of cascade particles. (auth)

16688 (CONF-730804-P3, pp 1811-1815) ABSOLUTE VERTICAL MUON SPECTRUM IN THE MOMENTUM RANGE 2 TO 1000 GeV/c. Abdel-Monem, M. S. (Univ. of Houston, TX); Benbrook, J. R.; Duller, N. M.; Green, P. J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The AMH magnetic spectrometer telescope was used to measure the absolute vertical spectrum in the range of 2-1000 GeV/c. The maximum likelihood technique was used to fit the momentum spectrum to a two parameter phenomenological model. The results are in good agreement with other recent measurements. (auth)

16689 (CONF-730804-P3, pp 1816-1821) CHARGE RATIOS OF COSMIC-RAY MUONS ARRIVING AT GROUND LEVEL FROM THE GEOMAGNETIC WEST. Bateman, B. J. (Texas A and M Univ., College Station); Duller, N. M.; Green, P. J.; Jelinek, A. V.; Sheldon, W. R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The AMH magnetic spectrometer (operated at Texas A&M University in collaboration with the cosmic ray group at the University of Houston) was used to measure the cosmic ray muon charge ratio as a function of momentum and zenith angle near sea level. The orientations of the spectrometer axis lie in a plane perpendicular to the magnetic meridian so that measurements at large zenith angles and low momenta are especially sensitive to effects of the geomagnetic field. The results are compared with detailed calculations which clearly demonstrate the geomagnetic separation of the effective sources of positive and negative muons arriving at ground level in a given direction. (auth)

16690 (CONF-730804-P3, pp 1822-1827) MUON CHARGE RATIO IN THE NEAR VERTICAL DIRECTION IN THE RANGE 10 TO 450 GeV/c. Ayre, C. A.; Baxendale, J. M.; Daniel, B. J.; Hume, C. J.; Nandi, B. C.; Thompson, M. G.; Wells, S. C.; Whalley, M. R.; Wolfendale, A. W. (Univ. of Durham, UK). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The results of measurements of the charge ratio made with the spectrograph MARS, and based upon 1.3×10^6 particles show that the ratio is fairly constant at 1.285 ± 0.002 over the momentum range 10 to 450 GeV/c. Using the latest available data on pion (and kaon) production charge ratios from the I.S.R., and assuming that in the important collisions where the secondary takes about 20% of the energy, in a fraction f of proton-neutron collisions the charge ratio is determined by the proton and in (1-f) by the neutron (the converse being true for n-p collisions), the overall mean charge ratio is consistent with an f value of 0.68 and a π^+/π^- ratio for p-nucleus interactions of 1.44. (auth)

16691 (CONF-730804-P3, pp 1828-1832) COSMIC-RAY MUON CHARGE RATIO MEASUREMENTS ABOVE 1 TeV. Ashley, G. K. II.; Keuffel, J. W.; Larson, M. O. (Univ. of Utah, Salt Lake City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The cosmic ray muon charge ratio was measured for muon momenta 0.7 to 4.5 TeV/c. The measurements, together with those at lower energies, are in good agreement with the predic-

tions of scaling for primary collision energies up to 40 TeV. (auth)

16692 (CONF-730804-P3, pp 1833-1838) HADRONIC SCALING AND THE CHARGE RATIO OF COSMIC-RAY MUONS. Morrison, J. L.; Elbert, J. W. (Univ. of Utah, Salt Lake City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The charge ratio of cosmic ray muons produced by meson decay was calculated with the assumption of scaling for high energy hadronic interactions. The values obtained are in good agreement with experimental results for muons coming from primary collision energies up to 40 TeV. This agreement and the observed near energy independence of the measured charge ratios support the scaling hypothesis with the limitation that they are insensitive to secondaries produced at very small fractions of the primary energy. (auth)

16693 (CONF-730804-P3, pp 1841-1846) ANALYTICAL EVALUATION OF PION, KAON, AND MUON DISTRIBUTIONS IN THE ATMOSPHERE. Lilland, A.; Pilkuhn, H. (Univ. of Karlsruhe, Ger.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The diffusion equation for charged pions has the form $(\partial\pi/\partial x + \pi(1/\lambda_\pi + B\pi/Ex \cos\theta)) =$ (nuclear source) + (mesic source), where $\pi(E, x, \theta)$ is the pion intensity at energy E, atmospheric depth x and direction θ with respect to the zenith, and $B_\pi = m_\pi ch_0\tau_\pi^{-1}$. This equation was solved by keeping in the nuclear source contributions from primary protons $p(E,x)$ and α-particles $\alpha(E,x)$, and in the mesic source contributions from $\pi(E,x,\theta)$. (CES)

16694 (CONF-730804-P3, pp 1847-1852) HORIZONTAL COSMIC-RAY MUON SPECTRUM AT SEA LEVEL. Bella, G.; Yeivin, Y. (Tel-Aviv Univ., Israel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Previous work on the vertical muon spectrum is generalized in this investigation. The diffusion equations are modified so that the cosmic ray beam at any zenith angle, down to the horizontal, can now be treated. Also, energy losses are taken into account. Experimental data on the nearly horizontal muon spectrum are used to determine the range of compatible values of the interaction model parameters. These results are discussed and compared with the corresponding vertical spectrum results. (auth)

16695 (CONF-730804-P3, pp 1853-1858) VERTICAL MUON SPECTRUM AND CHARGE RATIO AT SEA LEVEL. Wieder, M.; Yeiven, Y. (Tel-Aviv Univ., Israel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A simple, empirical high-energy nuclear collision model is used to derive the vertical muon spectrum and charge ratio at sea level. The parameters of the model are the collision inelasticity, the average multiplicity of the directly produced pions, the kaon/pion ratio, and the average hyperon "multiplicity". The relations among these parameters, imposed by the observed muon spectrum, are examined, and the range of their possible values consistent with this spectrum is determined. Also, the sensitivity of these results to the normalization and the slope of the observed muon spectrum is studied. Charge ratio data, however, are still insufficient to restrict the values of the parameters. (auth)

16696 (CONF-730804-P3, pp 1860-1865) CALCULATION OF MUON YIELDS, RESPONSE FUNCTIONS AND SEA-LEVEL INTEGRAL ENERGY SPECTRUM USING RECENT ACCELERATOR DATA AND FEYNMAN SCALING. Gaisser, T. K. (Bartol Research Foundation, Swarthmore, PA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The number of muons of energy greater than E_μ due to a primary nucleon of energy E_0 for $E_\mu \gtrsim 10$ GeV were calculated (assuming normal parentage for the muons) by solving the atmospheric diffusion equation governing the pion flux in the atmosphere, determining the corresponding muon production spectrum and hence the muon yields. This method assures that muons from pions many generations removed from the primary are included and, in addition, takes account of the effect of pion decay on the multiplication of the pion flux in the atmosphere. The basic input to the equation is the inclusive cross sections for the processes $pp \rightarrow \pi^\pm$ + anything and $\pi p \rightarrow \pi$ + anything as determined from recent accelerator data (including ISR data for pp interactions). These production spectra are extrapolated as necessary by use of the Feynman scaling hypothesis. A median primary energy ranging from about 15 E_μ at $E_\mu \sim 10$ GeV to about 10 E_μ at $E_\mu \sim 1000$ GeV is found. The derived sea level integral muon energy spectrum is in good agreement with the observed spectrum. (auth)

16697 (CONF-730804-P3, pp 1866-1870) MUON GROUPS UNDERGROUND. Rogers, I. W.; Wright, A. G. (Polytechnic of North London, Holloway). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Bundles of muons underground were studied, using an apparatus consisting of two stacks of three liquid scintillation counters each, at depths of 71.6 hg cm^{-2} and 460 hg cm^{-2}. The measured intensities of pairs of parallel muons were $(64 \pm 5)d^{-1}$ at 71.6 hg cm^{-2} and $(3.0 \pm 0.5)d^{-1}$ at 460 hg cm^{-2}. A lower limit for the rate of higher multiplicity events at 71.6 hg cm^{-2} was found to be $(5.5 \pm 0.9) \times 10^{-1}d^{-1}$. (auth)

16698 (CONF-730804-P3, pp 1872-1877) MUONS OF ENERGY GREATER THAN 1800 GeV IN EAS. Naranan, S.; Sivaprasad, K.; Sreekantan, B. V.; Srinivasa Rao, M. V. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Results from the KGF air shower array show that in the size range 6×10^5 to 2×10^6 particles at 920 gms/cm^2, the number of muons of energy greater than 1.8×10^{12} ev increase with size as N_e 0.41 ± 0.24. There is sudden increase in muon number by a factor of ~7 beyond a shower size of 2×10^5 particles. Also the energy spectra of muons in the energy range 10^{11} to 2×10^{12} ev are considerably different in showers of size less than and greater than 2×10^5 particles. (auth)

16699 (CONF-730804-P3, pp 1878-1883) MEASUREMENT OF MULTIPLE MUON RATES UNDERGROUND. Lowe, G. H.; Bergeson, H. E.; Keuffel, J. W.; Sandberg, V. D.; Ozaki, S. (Univ. of Utah, Salt Lake City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

New and more extensive data on multiple muons underground are presented as rates for various multiplicities in a fiducial plane of 80 m^2. The results are in agreement with the scaling model calculations of Elbert and Mason in the range 10-1000 TeV. (auth)

16700 (CONF-730804-P3, pp 1884-1889) OBSERVATIONS ON MUON SHOWERS UNDERGROUND. I. The Multiplicity Distribution. Bergamasco, L. (CNR, Turin); Castagnoli, C.; D'Ettorre Piazzoli, B.; Sitte, K.; Picchi, P.; Visentin, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Groups of penetrating particles have been recorded in two spark chamber telescopes, each of 2m^2 area, installed in the Mt. Cappuccini Laboratory at 40 mwe underground. The multiplicity dependence of the absolute rate of events is used to test various assumptions concerning shower production in the size range $10^5 \lesssim N_e \lesssim 10^7$. It is concluded that the change in the slope of the size distribution which occurs in this interval cannot be ascribed to significant changes in the interaction characteristics, or in the primary composition. It must be due to astrophysical features reflected in a genuine change of the primary spectrum. (auth)

16701 (CONF-730804-P3, pp 1890-1895) OBSERVATION ON MUON SHOWERS UNDERGROUND. II. The Angular Spread. Dardo, M. (CNR, Turin); D'Ettorre Piazzoli, B.; Sitte, K.; Picchi, P.; Visentin, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The angular distribution of the shower particles recorded in a spark chamber array at a depth of 40 mwe was analyzed. Besides a dominant group with small angular spread, about 10% of particles traversing the chambers at large angles to the shower direction was found. Among them some 43% underwent large-angle scattering interactions in the chamber, while among the parallel tracks only about 0.75% of such cases was seen. From the frequency, the energy estimates, and the path length in rock of the "non-parallel" tracks it is concluded that not all the particles

responsible for them are muons or secondary pions resulting from a muon interaction in the rock nearby. (auth)

16702 (CONF-730804-P3, pp 1896-1901) OBSERVATIONS ON MUON SHOWERS UNDERGROUND. III. Local Interactions. Dardo, M. (CNR, Turin); D'Ettore Piazzoli, B.; Piano, A.; Sitte, K.; Picchi, P.; Visentin, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Secondary interactions of the penetrating shower particles in the absorbers of a spark chamber array were studied. Knock-on electrons and small electron cascades were found in frequencies consistent with expectations. But a surprisingly high rate of large-angle scattering events, and a surprisingly low rate of penetrating secondary showers, were seen both in the runs with shower triggering, and in the single-muon tests. It is shown that this is incompatible with the interpretation of the non-electromagnetic interactions as due to pions originating in the rock above the apparatus. (auth)

16703 (CONF-730804-P3, pp 1902-1906) MUON ENERGY SPECTRUM IN EAS. Khrenov, B. A.; Khristiansen, G. B. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The electromagnetic interactions of EAS muons were investigated at a depth of 40 MW(e) underground with the help of 4 rows of wide gap spark chambers intervened with the layers of lead. The numbers of successive interactions of individual muons are presented. These numbers are compared with the expected ones for various muon energy spectra in EAS. The experiment gives the upper limit for the high energy muon flux in EAS. For more precise results in the energy range of $E \geq 1000$ GeV the measurement with the help of IO-layer detector are to be carried out. (auth)

16704 (CONF-730804-P3, pp 1904-1919) HORIZONTAL AIR SHOWERS (HAS) INVESTIGATION. Volovik, V. D.; Zalyubovskii, I. I.; Ivanov, A. D.; Kaminskii, A. T.; Kartashov, V. M.; Baranik, A. T. (Kharkov State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

With the help of complex special installation used for horizontal air showers study the spectrum of these showers on the particles number (N_e) in the range $2 \cdot 10^2 \leq N_e < 3 \cdot 10^3$ has been received and it was shown that the integral spectrum ratio of these showers $n = 2.7 \pm 0.4$. Showers distribution on zenith angle value $\theta \geq 70°$ has its maximum at $\theta \sim 86°$. The comparison of the present results with data about HAS that has been received by other authors and also with the energetic spectrum of horizontal μ-meson is discussed. (auth)

16705 (CONF-730804-P3, pp 1908-1912) INVESTIGATION OF MUON GROUPS NEAR THE AXIS OF EXTENSIVE AIR SHOWERS. Basarov, E. V.; Beisembaev, R. V.; Beschapov, S. P.; Vavilov, Y. N.; Kayumov, E. F.; Meshkov, E. A.; Rivkin, Y. A. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Preliminary results of the investigation of muon groups in the E.A.S. on the installation with spark chambers in complex Tian Chan installation is presented. Due to significant increase of the accuracy of muon angles determination (up to 2 milliradians) the new approach to muon groups investigation is developed. It consists in the analysis of the angles characteristics of groups. This method permits, in particular, to search muon pairs created in upper layer of the ground above the installation, or in ionization calorimeter placed above the installation on earth surface. Muon pairs can be created in strong interaction of hadrons by virtual photons and in new hypothetical processes. (auth)

16706 (CONF-730804-P3, pp 1921-1922) ANGULAR DISTRIBUTION OF LOW-ENERGY MUONS AT A DEPTH OF 417 hg cm^{-2} UNDERGROUND. Bhat, P. N.; Ramana Murthy, P. V. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An experiment is in progress at a depth of 417 hg cm^{-2} (1 hg cm^{-2} = 100 g/cm^{-2} of matter) for the past few weeks to measure the angular distribution of muons that come to rest in a 444 litre liquid scintillator and decay. The experimental arrangement is described, and the very preliminary results obtained so far are given. The statistics, as yet, are too poor to give a precise idea of the angular distribution. (auth)

16707 (CONF-730804-P3, pp 1923-1928) FLUX OF STOPPING MUONS AT A DEPTH OF 985 hg cm^{-2} UNDERGROUND. Bhat, P. N.; Ramana Murthy, P. V. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Results at depths 96 and 417 hg cm^{-2} from a systematic investigation of the fluxes of cosmic ray muons that come to rest and decay at various depths underground were previously reported. Since then the measurements have been extended to a depth of 985 hg cm^{-2} where the flux of stopping muons were measured to be $(6.9 \pm 0.7)\ 10^{-3}$ muons/cm^2/sec/ster/hg cm^{-2} of rock. A few details are given and results are discussed. (auth)

16708 (CONF-730804-P3, pp 1930-1935) STOPPING MUONS ACCOMPANIED BY PENETRATING PARTICLES UNDERGROUND. Higashi, S. (Osaka Univ.); Ozaki, S.; Miono, S.; Takahashi, T.; Tsuji, K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The flux of stopping muons at a depth of 24 hg cm^{-2} underground was measured with the detector which consists of plastic scintillators and lead absorbers. Stopping muons accompanied by penetrating particles could be distinguished from stopping atmospheric muons. The ratios of the total stopping muon flux to penetrating muon flux and the accompanied stopping muon flux to that are $(3.0 \pm 0.5) \cdot 10^{-2}$ and $(2.8 \pm 0.5) \cdot 10^{-6}$ respectively for the detector of 100 g cm^{-2} thickness. The rate of accompanied stopping muons agrees with expectation. (auth)

16709 (CONF-730804-P3, pp 1936-1940) INTENSITY OF $\mu \rightarrow e^-$ DECAYS AT DIFFERENT DEPTHS UNDERGROUND. Alekseev, E. N.; Chudakov, A. E.; Gurentsov, V. A.; Mikheev, S. P.; Tizengausen, V. A. (Inst. for Nuclear Research, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The intensity of $\mu \rightarrow e$ decays in liquid scintillator is measured at effective depths 60,850 and 1150 hg cm^{-2}. The ratio of stopping muons to through-going ones, as normalized to 100 g cm^{-2} thickness of scintillator is found to be correspondingly $(3.5 \pm 0.3) \cdot 10^{-2}$, $(4.5 \pm 0.9) \cdot 10^{-3}$ and $(4.2 \pm 0.7) \cdot 10^{-3}$. The first value is completely explained by stopping atmospheric muons, the second and the third are about two times higher than the expectation for this source. All three values are in agreement with calculated yield of $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ decays from hadronic cascades locally produced by energetic muons. The data of Turin group at 4270 hg cm^{-2} scarcely can be explained in a similar way. (auth)

16710 (CONF-730804-P3, pp 1941-1946) LOCAL PRODUCTION OF SECONDARY PARTICLES DEEP UNDERGROUND. Bazer-Bachi, A. R. (Univ. of Houston, TX); Benbrook, J. R. Sheldon, W. R.; Vedrenne, G.; Dumet, C.; Duller, N. M.; Cantrell, W. G.; Grupen, C. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

In a preliminary run of the Mont Blanc muon hodoscope-telescope, the absorber used between the middle and bottom trays of geiger counters in two of the four detector arrays was 10 cm of lead plus 1 cm of iron. In the other two detector arrays the absorber consisted of only 1 cm of iron. From a sample of 3800 events, 14% more events (6 standard deviations) were detected in the no-lead arrays. This 14% excess is attributed almost entirely to locally-produced electrons which stop in 10 cm of lead. Confirmation is provided by comparison of bursts originating in nearby rocks where twice as many events of this type (7% of the total) are found in the no-lead array. This result provides a measurement of the soft background which could contaminate measurements of other types of stopping particles underground. An analysis of the measured burst size spectrum at depths of 1000 to 4000 hg/cm^2 is found to be in qualitative agreement with conventional models for muon-electron scattering. (auth)

16711 (CONF-730804-P3, pp 1947-1952) INVESTIGATION OF DEPTH-INTENSITY CURVE OF NUCLEAR EVENTS INDUCED BY MUONS. Bezrukov, L. B.; Beresnev, V. I.; Ryajskaya, O. G.; Stepanets, L. N.; Zatsepin, G. T. (Inst. for Nuclear Research, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A study of depth-intensity curve of neutrons produced by muons is described. The experiments were made in a salt mine at a depth of 316 m.w.e. underground and in a gypsum mine at a depth of 25 m.w.e. It was determined that the number of neutrinos produced by fast muons normalized to one muon, increased as $\bar{E}_\mu^{0.7}(x)$, where $\bar{E}_\mu(x)$ is average muon energy at a depth x. This depth-intensity curve of neutrons produced by muons agrees with theoretical curve which was obtained in consideration of development of nuclear cascades. (auth)

16712 (CONF-730804-P3, pp 1954-1957) MEASUREMENT OF THE TOTAL PHOTO-NUCLEON CROSS SECTION AT VERY HIGH ENERGIES THROUGH COMPARISON OF MUON DEPTH-INTENSITY MEASUREMENTS WITH INTENSITY MEASUREMENTS MADE WITH SPECTROMETERS. Adair, R.; Kasha, H.; Kellog, R. (Yale Univ., Cambridge, MA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Measurements of the vertical muon intensity, made with the Yale-BNL Spectrometer, were used to calculate the intensity vs depth underground using Monte Carlo techniques which treat the diffusion of muons through rock exactly if the energy loss mechanisms are known. Calculations using preliminary spectrometer data, which extends up to 2000 GeV, are compared to depth intensity measurements where various assumptions are made for the photo-nucleon total cross section at energies above 15 GeV, the limit of present machine measurements. This comparison suggests that the cross section from 100 GeV to 2000 GeV is consistent with the value of about 100 microbarns measured at 15 GeV and is unlikely to be greater than 200 microbarns. (auth)

16713 (CONF-730804-P3, pp 1958-1961) SOLAR NEUTRINO BACKGROUND AND THE PHOTONUCLEAR CROSS SECTION. Cassiday, G. L. (Univ. of Utah, Salt Lake City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An upper limit of $\sigma_\gamma < 3000\ \mu b$ is obtained for the photonuclear cross section at photon energies near 100 GeV based on an analysis of the depth dependence of the underground argon production rate ($^{37}Cl \rightarrow {}^{37}Ar$) measured in the solar neutrino experiment. In addition, the solar neutrino background rate due to fast muon interactions is estimated to be 0.047 events/day (0.06 SNU). This is to be compared with the measured value of 0.16 ± 0.10 events/day (0.20 ± 0.12 SNU). (auth)

16714 (CONF-730804-P3, pp 1977-1981) OBSERVATION OF STRUCTURAL BURSTS PRODUCED BY HIGH-ENERGY MUONS IN THE ROCK. Honda, K.; Takahashi, T.; Higashi, S.; Ozaki, S. (Osaka Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Lateral structure of bursts produced by high energy muons in the rock have been observed at a depth 30 mwe underground by use of two layers of proportional counters. The number of structural bursts observed, which have two bursts in both layers ($N_1 \geq 200$, $N_2 \geq 20$ particles) is 61, 4.4% of total events. These structural bursts have two types; 1) incident directions of two bursts are parallel, 2) two bursts intersect in the rock within 2 m above the tunnel. The latter is likely to be caused by nuclear active particles produced in the process of the nuclear interaction of high energy muons in the rock. (auth)

16715 (CONF-730804-P3, pp 1892-1987) ENERGY DEPENDENCE OF THE NUCLEAR INTERACTION CROSS-SECTION OF COSMIC MUONS IN THE RANGE 0.3 TO 3 TeV. Borog, V. V.; Kirillov-Ugryumov, V. G.; Kokoulin, R. P.; Petrukhin, A. A. (Physical Engineering Inst., Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Cascade showers ($\epsilon \geq 200$ GeV) produced by cosmic muons at large zenith angles were studied using an ionization calorimeter. The nuclear showers were separated from electromagnetic ones by means of the χ^2-test. The energy spectrum of nuclear showers is in accordance with the power dependence of the cross section $\sigma \sim E^\alpha/\epsilon$ on the muon energy E if α is 0.06 ± 0.06 in the region 300-3000 GeV. The estimation of the photonuclear cross section $\sigma_{\gamma Fe}$ on the basis of Hand expression gives a nearly constant value over the photon energy range from 200 to 2000 GeV. (auth)

16716 (CONF-730804-P3, pp 1988-1993) POSSIBLE EXISTENCE OF ANOMALOUS MUON INTERACTION AT ENERGIES ABOVE 10 TeV. Kalmykov, N. N.; Khristiansen, G. B. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Hypothesis of anomalous >10 TeV muon interaction is considered to explain the contradition between experimental muon spectra obtained using ionization chambers ($J_\mu \simeq 2$) and x-ray films ($J_\mu \simeq 2.6$). Approximate characteristics of this interaction were determined, and the hypothesis of its existence was shown not to contradict the observed intensity of horizontal air showers. (auth)

16717 (CONF-730804-P3, pp 1994-1999) CALIBRATION OF LARGE VOLUME NONDIRECTIONAL CHERENKOV COUNTER FOR NEUTRINO DETECTION. Bozoki, G. (Univ. of Pennsylvania, Philadelphia); Frati, W.; Lande, K.; Lee, C. K.; Fenyves, E. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A technique for the calibration of large volume nondirectional Cerenkov counter using positrons from stopping cosmic ray muons was developed. The results obtained with a $2m^3$ counter module show that the detection of extraterrestrial antineutrino bursts from collapsing stars with detector systems built from these modules is feasible. (auth)

16718 (CONF-730804-P3, pp 2032-2037) CHARACTERISTIC INTERACTIONS OF INCOHERENT COSMIC-RAY PARTICLES OBSERVED USING A FLASH-TUBE CHAMBER. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Typical interactions produced by incoherent cosmic ray particles traversing a flash tube chamber are classified and their frequency of occurrence given. The only unexpected types of event observed are events in which (a) a penetrating particle produces a single backward secondary which traverses 15 cm of iron (2 events) and (b) a stopping particle which produces 3 charged secondaries (1 event). (auth)

16719 (CONF-730804-P3, pp 2038-2041) MULTIPLE SCATTERING OF COSMIC-RAY MUONS. Osborne, A. R. (Univ. of Houston, TX); Abdel-Monem, M. S.; Benbrook, J. R.; Sheldon, W. R.; Duller, N. M.; Green, P. J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The multiple scattering distribution for cosmic ray muons in iron was measured using the AMH magnetic spectrometer telescope. Results indicate that there is no significant deviation from theory for the measured momentum range (2-500 GeV/c) and target thickness (.9 meters of iron). (auth)

16720 (CONF-730804-P3, pp 2042-2044) ELECTROMAGNETIC INTERACTIONS OF COSMIC-RAY MUONS. Osborne, A. R. (Univ. of Houston, TX); Abdel-Monem, M. S.; Benbrook, J. R.; Sheldon, W. R.; Duller, N. M.; Green, P. J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An anomalous charge asymmetry for cosmic ray muon interactions has been reported by several investigators. A measurement of the charge asymmetry for electromagnetic interactions of cosmic ray muons in iron is reported using data from the AMH magnetic spectrometer telescope. Muon interactions producing 1-9 secondary particles were investigated in the energy range 2-200 GeV/c. For interactions involving two or more secondary particles, the ratio of the interaction cross-section for positive muons to that of negative muons was found to be $1.34 \pm .14$. Thus we find evidence for a muon interaction charge asymmetry. (auth)

16721 (CONF-730804-P3, pp 2045-2050) SPECIFIC IONIZATION OF COSMIC-RAY MUONS IN THE MOMENTUM RANGE 3 TO 200 GeV/c. Basu, P. S.; Nandi, B. C.; Sinha, M. S. (Regional Engineering College, Durgapur, India). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Specific ionization of relativistic muons was studied in helium and argon separately by the method of drop counting in their

tracks in a cloud chamber in the momentum range 3–200 GeV/c. The Durgapur Cosmic Ray Spectrograph was utilized to measure the momenta of the individual muons. The results reported agree well with the theoretical expression suggested by Sternheimer (1971). (auth)

16722 (CONF-730804-P3, pp 2051-2056) CHARGE DEPENDENCE OF ELECTROMAGNETIC INTERACTIONS OF COSMIC-RAY MUONS. Nandi, B. C.; Sinha, M. S. (Regional Engineering College, Durgapur, India). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The dependence of the electromagnetic interaction cross section of cosmic ray muons in the momentum range 5–100 GeV/c was investigated by means of the Durgapur Cosmic Ray Spectrograph. The ratio of the interaction cross section for positive and negative muons was found to be 0.952 ± 0.045 for the production of single electron secondaries by the knock-on process. For the production of two and more than two electron secondaries the ratios are 1.05 ± 0.09 and 0.91 ± 0.08 respectively. The results of the present experiment do not suggest any charge asymmetry of cosmic ray muons in respect of electromagnetic interactions in iron. (auth)

16723 (CONF-730804-P3, pp 2124-2125) TRANSVERSE MOMENTA FROM AN AIR-SHOWER STUDY. Hazen, W. E.; Hodson, A. L.; Winterstein, D.; Keller, O. (Univ. of Leeds, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The new results on high transverse momenta in pion production at the ISR give renewed interest in the possibility of very high transverse momenta appearing at cosmic-ray energies. We are looking for evidence from subcores in air showers for high transverse momenta. Since we are measuring particle densities in subcores with a cloud chamber (observation area 1.5m × 2m) we may avoid some of the problems associated with previously used detectors. (auth)

16724 (CONF-730804-P3, pp 2126-2128) MULTIPLE HADRON EVENTS NEAR SEA LEVEL. Baruch, J. E. F.; Brooke, G.; Kellermann, E. W. (Univ. of Leeds, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

About 12 hadronic events have been observed which give rise to a region of very high ionization and which often show another particle at a distance of 1 m or so from the main beam. It is considered likely that these events are due to the incidence of primaries heavier than protons. (auth)

16725 (CONF-730804-P3, pp 2129-2134) MEASUREMENT OF FLUX OF CHARGED HADRONS ABOVE 300 GeV AT SEA LEVEL. Siohan, F.; LaPointe, M.; MacFall, J.; Stottlemyer, A.; Ellsworth, R. W.; Yodh, G. B. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The charged hadron flux at sea level was measured with an ionization calorimeter. The calorimeter had an area of 4 m^2, a total depth of 8 interaction lengths. It had 7 layers of liquid scintillator counters and 3 spark chambers, to measure and observe the cascade development. The apparatus also included a beam spark chamber and a 4 m^2 scintillation counter above the calorimeter. The threshold for triggering was 300 GeV. The differential fluxes were determined to be $(2.6 \pm 0.7) \times 10^{-7}$ $(E\ (GeV)/350)^{-3.3 \pm 0.3}$ for single hadrons unaccompanied over 4 m^2 in the range $350 < E < 1000$ GeV; and $(1.23 \pm 0.24) \times 10^{-6}$ $(E\ (GeV)/350)^{-3.35 \pm 0.25}$ for all single hadrons in the same energy range. Units are particles/m^2, sr · sec · GeV. (auth)

16726 (CONF-730804-P3, pp 2135-2139) MEASUREMENT OF THE CHARGED HADRON FLUX AT 9500 FEET. Siohan, F.; LaPointe, M.; MacFall, J.; Ito, A.; Stottlemyer, A.; Streitmatter, R.; Tonwar, S. C.; Ellsworth, R. W.; Yodh, G. B. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The charged hadron flux from 100 to 1200 GeV was measured with a 4 m^2, 8 interaction length calorimeter, at 730 gm/cm^2. The apparatus was operated with an 80 GeV threshold; large plastic scintillators of total area 3.3 m^2 were placed in anticoincidence to reduce the background of accompanied hadrons. The differential vertical flux of charged single hadrons unaccompanied over 5 m^2 was measured to be: $dN/dE = (7.95 \pm 0.9) \times 10^{-6}$ $(E(GeV)/100)^{-3.2 \pm 0.1}$ part/m^2 · sr · sec · GeV · for $100 < E < 1200$ GeV. (auth)

16727 (CONF-730804-P3, pp 2140-2144) FLUXES OF UNACCOMPANIED HADRONS IN THE ATMOSPHERE AT HIGH ENERGIES. Gaisser, T. K. (Bartol Research Foundation, Swarthmore, PA); Yodh, G. B. 1973.

From 13th international cosmic ray conference; Denver, Colorado. USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Fluxes of pions and nucleons are calculated for various energy thresholds in the 100–10000 GeV range and for various atmospheric depths. The fluxes calculated are those corresponding to experiments that detect single hadrons (i.e. hadrons unaccompanied by other particles over some specified area). The unaccompanied requirement means that single hadron experiments detect on the average only particles removed by more than some minimum distance from the core of the shower that accompanies the ancestral primary cosmic ray, or those whose shower has died away. As a consequence of differences in their production spectra, pions and nucleons will appear in different ratios, depending on the stringency of the unaccompanied requirement. It is to be emphasized that existing calculations of uncorrelated hadronic fluxes in the atmosphere fail to take into account this experimental trigger requirement. (auth)

16728 (CONF-730804-P3, pp 2145-2150) HIGH-ENERGY NUCLEAR ACTIVE PARTICLES IN THE ATMOSPHERE. Kempa, J.; Wdowczyk, J.; Zujewska, E. (Univ. of Lodz, Poland). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A compilation has been made of experimental data on the energy spectrum of the higher energy nuclear active component in the atmosphere. The compilation is used to give an estimate of the energy spectrum of primary nucleons in the energy range 10^{12}–10^{16} eV; this spectrum is found to agree with that estimated on the basis of high energy muons. Possible models of high energy interactions are discussed from the point of view of agreement as to variety of other cosmic ray data. (auth)

16729 (CONF-730804-P3, pp 2151-2156) PROPAGATION OF SECONDARY ELECTRON–PHOTON COMPONENT OF THE COSMIC RADIATION IN THE ATMOSPHERE IN THE REGION 1 MeV TO 10 GeV. Daniel, R. R.; Stephens, S. A. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Theoretical studies of the propagation of electromagnetic component in the atmosphere have not been seriously undertaken so far, especially at low energies, on a global basis. Results are presented from a detailed calculation of the development of electron–photon component in the atmosphere from 0 to 1000 g. cm^{-2}, over a wide energy region of 1 MeV to 10 GeV, by taking into account the varying contributions from the propagation of hadronic and leptonic components as a function of latitude and atmospheric depth. These results were compared with those of earlier calculations and available experimental data. (auth)

16730 (CONF-730804-P3, pp 2162-2165) ENERGY DEPENDENCE OF ENERGY SHARE TRANSFERRED BY HADRONS INTO THE SOFT COMPONENT. Nam, R. A.; Nikolskii, S. I.; Pavlyichenko, V. P.; Chubenko, A. P.; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The energy share K_γ transferred into electron-photon component by hadrons in hadron-nuclei of lead interactions as hadron cascade form was investigated. The K_N value for nucleons-nuclei interactions decreases (from 0.20 down to 0.15) as energy grows from 2 up to 8 TeV. The value of K_H for total hadron flux of cosmic radiation at mountain level is constant with ±3% precision and it is equal to 0.24 up to $E \sim 10$ TeV and it increases by 20% at greater energies. (auth)

16731 (CONF-730804-P3, pp 2197-2202) ATTENUATION OF HEAVY NUCLEI INTENSITIES IN THE ATMOSPHERE BY FRAGMENTATIONS. Allkofer, O. C.; Heinrich, W. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Since direct measurement of fragmentation probabilities and the interaction mean free paths of heavy nuclei in air is not yet

feasible, these quantities are generally deduced from measurements in emulsions. Combining the results of measurements with plastic stacks in 40 g cm^{-2} and earlier results obtained with emulsions and in counter measurements, the fragmentation probabilities in air have been determined by comparison with the primary spectra of different charge groups. This was done calculating the energy spectra in the atmosphere taking into consideration the fragmentation and energy loss of the nuclei. By this calculation the different measurements in the energy range from 100 MeV/nucl. to several GeV/nucl. can be reproduced using energy independent fragmentation probabilities. (auth)

16732 (CONF-730804-P3, pp 2204-2209) SOME RESULTS OF HIGH ENERGY INTRANUCLEAR CASCADE SIMULATIONS IN NUCLEON–NUCLEUS INTERACTIONS. Grieder, P. K. F. (Univ. of Bern). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A strongly simplified model to describe nucleon–nucleus interactions has been worked out and was used to study the significance of the intranuclear cascade in very high energy nucleon–nucleus interactions. Particular consideration was given to possible consequences for the air shower process. Results, including the energy and target mass dependence of the multiplicity, elasticity, and momentum distributions of secondaries are presented and discussed. (auth)

16733 (CONF-730804-P3, pp 2219-2226) ATMOSPHERIC PHENOMENA OF EXTREMELY HIGH-ENERGY COSMIC-RAY COMPONENTS. Japanese and Brasilian Emulsion Chamber Group. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Analysis was made on the atmospheric cosmic-ray phenomena of energy $\gtrsim$100 TeV, based on ~3400 electrons and gamma-rays with E $\gtrsim$ 2 TeV and ~600 families with $\Sigma E\gamma \gtrsim 5$ TeV, observed in Chacaltaya emulsion chamber of 46.8 m^2. Energy spectra of electromagnetic and nuclear active components, size spectrum of families are presented, and discussion is given on its significance to the characteristics of ultra high energy nuclear interactions. (auth)

16734 (CONF-730804-P3, pp 2228-2232) PRELIMINARY RESULTS OF INVESTIGATION OF HADRON INTERACTIONS AT ENERGY APPROX. 10^6 GeV. Anischenko, Yu. V. (Lebedev Inst. of Physics, Moscow); Baradzei, L. T.; Dobrotin, N. A. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The emulsion chamber (area 20 m^2) of a new type which is a sandwich of lead and carbon layers and interposed x-ray films was exposed to the cosmic radiation at Pamir (altitude 4370 m). Angular and energy spectra of hadron and γ-ray components are obtained. Families of γ-quanta and, for the first time, families of hadrons produced in interactions with energy ~10^6 GeV in air above the chamber are found. Preliminary analysis of these families gives an evidence for appreciable fluctuations in the process of their production at super-high energy. (auth)

16735 (CONF-730804-P3, pp 2250-2256) LARGE-AREA EMULSION CHAMBER EXPERIMENT AT MT. FUJI. Kasahara, K. (Utsunomiya Univ., Japan); Mito, I.; Ohsawa, A.; Taira, T.; Torri, S. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The emulsion chamber project aiming to research characteristic features of nuclear interaction in super-high energy has been started at Mt. Fuji, through the observation of air shower cores with energies greater than 10^{15} eV, complementary to the Chacaltaya emulsion chamber experiment. The exposure list so far made is briefly discussed. (auth)

16736 (CONF-730804-P3, pp 2258-2262) ELECTRON-PHOTON COMPONENTS OF COSMIC RAYS AT MOUNTAIN ALTITUDE. Cherdyntseva, K. V.; Nicolskii, S. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Series of experiments using x-ray films to detect the electron-photon components are carried out at the altitude 3340 m. The intensity of the electromagnetic components when E $\geq$ 1 Tev is equal to: $N(>E) = (2.8 \pm 0.4) \cdot 10^{-2}$ γ rays/m^2 hour ster., the value of exponent of energy spectrum of γ rays is equal to 1.7 ± 0.2. The families of γ rays with summary energy $\geq$40 TeV are also analyzed and some γ rays are observed, which generation can be connected with the second heavier fire-ball, but not with the first one. However, the high threshold energy detecting γ rays decreases the number of the particles observed and does not permit to see the fire-balls in the inertial centers of colliding nucleons. (auth)

16737 (CONF-730804-P3, pp 2263-2268) γ-RAY FAMILY FLUCTUATIONS AT $\Sigma E\gamma$ SELECTION. Apanasenko, A. V.; Smorodin, Yu. A.; Solopov, E. A. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The effect of γ-ray family fluctuations on experimental data are emphasized by selection of γ-ray families with total energy $\Sigma E\gamma$ and by energy and angular thresholds of γ-ray registration. The changes of γ-ray family characteristics are calculated by a Monte-Carlo method, γ-ray families being produced according to the model of heavy pion cluster decay. The mass formed by neutral pions was found to be about 1.5 as large as a mean value. The obtained energy and angular distributions as well as the multiplicity distributions of γ rays are in a good accordance with known experimental data. (auth)

16738 (CONF-730804-P3, pp 2269-2274) PRODUCTION OF CHARGED AND NEUTRAL PIONS OF ENERGIES OF 1 TO 10 TeV IN THE ATMOSPHERE. Baradzei, L. T.; Budilov, V. K.; Kanevskaya, E. A.; Smorodin, Yu. A.; Shalagina, E. V. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The photon spectra at atmospheric depths of 197 and 700 g/cm^2 and muon bremsstrahlung spectrum at sea level were studied using the same emulsion chamber. Identity of the energy measurements has permitted the production ratio $N_{\pi^\pm}/N_{\pi^0}$, to be determined without methodical shifts. The calculated pion production spectra are indicative of scaling conservation up to 20 TeV pion energies and of charge symmetry. (auth)

16739 (CONF-730804-P3, pp 2305-2310) CALCULATION FOR MORPHOLOGICAL STUDY WITH THE EMULSION CHAMBER. Kasahara, K.; Mito, I.; Osawa, A. (Univ. of Tokyo). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In the 13th international cosmic ray conference. Vol. 3.

Assumptions and computational procedures are discussed for emulsion chamber measurements of the quantity, $\Sigma E\gamma$, the total energy of γ-rays with energy higher than the certain threshold in a family. A group of particles is said to be "family" if its origin is reduced to one and the same primary cosmic ray particle. Therefore $\Sigma E\gamma$ reflect both the energy of an incident particle and the mechanism of how the energy is transformed into high energy γ-rays. $\Sigma E\gamma$ is a stable quantity, where stable means that the error involved in the measured energy of an individual γ-ray is reduced if all γ-ray energies are summed up (as the central limiting theorem tells) and a family of a certain $\Sigma E\gamma$ is hardly overlooked during the scanning of events. (CES)

16740 (CONF-730804-P3, pp 2326-2331) DISCUSSION ON EXPERIMENTAL COSMIC-RAY MUON SPECTRUM IN THE ENERGY RANGE $10^3 + 10^{13}$ EV. Volkova, L. V.; Zatespin, G. T. (Inst. for Nuclear Research, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An analysis of experimental data on cosmic ray muon spectrum is done. It is shown that in the interval 30 to 5000 GeV experimental spectrum agrees well with the spectrum calculated on the base of scaling model for nuclear interactions of primary radiation with air nuclei. In the range of larger and lesser energies these spectra do not agree with each other. (auth)

16741 (CONF-730804-P3, pp 2332-2335) COSMIC-RAY MUON POSITIVE EXCESS AND THE PRIMARY COSMIC RAY INTERACTIONS IN THE ATMOSPHERE. Volkova, L. V.; Zatsepin, G. T. (Inst. for Nuclear Research, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Scaling model of nuclear interactions brings to the increase of positive cosmic ray muon excess with muon energy. The ratio

of the number of positive pions to negative ones generated in a nuclear interaction of proton with air nucleus received from cosmic ray muon positive excess does not agree with that received from accelerator data. (auth)

16742 (CONF-730804-P3, pp 2356-2367) CALCULATION OF SECONDARY COSMIC-RAY FLUXES USING ACCELERATOR DATA AND SCALING. Adair, R. K.; Kasha, H.; Kellogg, R. (Yale Univ., New Haven, Conn.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The secondary products of the interaction of the primary cosmic ray flux with the atmosphere are calculated using Monte Carlo techniques where the character of the nucleon-nucleon interactions is taken from accelerator data on interactions up to 1500 GeV. The character of the interactions at higher energies is deduced from the lower energy data using scaling laws. Meson-nucleon interactions are treated by extrapolating accelerator data at 30 GeV to higher energies using scaling. Fluxes of protons, neutrons, mesons and muons are calculated as a function of depth in the atmosphere. In particular, the muon charge asymmetry, the muon sea-level flux, and the hadron attenuation length are calculated as a function of energy and compared to experiment. (auth)

16743 (CONF-730804-P4) 13th INTERNATIONAL COSMIC RAY CONFERENCE, DENVER, COLORADO, 17–30 AUGUST 1973. Volume 4. AS and TI Sessions. (Denver Univ., Colo. (USA)). 1973. 760p. Dep. NTIS $41.00.

Separate abstracts are prepared for 112 of the 114 papers included. Two papers were previously abstracted in NSA as 29: 2681 and 8233. (CES)

For abstracts of individual papers see: 15543–15557, 15641–15643, 15653–15683, 16744–16804, 16897, and 17121.

16744 (CONF-730804-P4, pp 2369-2374) OPTICAL CHERENKOV EMISSION FROM LARGE AIR SHOWERS. Smith, G. J.; Turver, K. E. (Univ. of Durham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

An account is given of detailed computer simulations of the Cherenkov radiation to be expected in the largest air showers (primary energies as high as 10^{18} eV) together with preliminary data from measurements made in large showers at the Haverah Park array. (auth)

16745 (CONF-730804-P4, pp 2375-2377) STUDY OF TEMPORAL STRUCTURE OF EAS BY MEANS OF CHERENKOV LIGHT. Bosia, G.; Navarra, G.; Saavedra, O.; Bohm, E.; Cachon, A. (CNR, Turin, Italy). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

An array of Cherenkov detectors has been installated at the Pic du Midi Observatory (2860 masl) and operate in conjunction with an array for EAS detection. The aim of the experiment is to make a study of the time fine structure of the showers in the energy range 10^{12}–10^{15} eV through the temporal distribution of Cherenkov light. To this purpose Cherenkov detectors with a subnanosecond time response and a new fully automatic data storage have been used. A detailed time profile is then obtained by means of the analysis of the pulse shape. The local and integrated pulses structure has been analyzed as function of the main EAS parameters. (auth)

16746 (CONF-730804-P4, pp 2378-2383) EAS CHERENKOV RADIATION PULSE FORM. Efimov, N. N.; Krasilnikov, D. D.; Khristinsen, G. B.; Shikalov, F. V.; Kuzmin, A. I. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The results of the study of the Cherenkov radiation pulse form to EAS's with particle numbers of 3×10^6–3×10^8 at distances of $200 < r_\perp < 600$ m from the shower axis as obtained on the Yakutsk installation are presented. Dependences of the pulse width on the distance to EAS axis and on the shower particle number ratio to Cherenkov signal amplitude are presented. The pulse form irregularity events which cannot be explained by superposition of night sky noises are presented. Experimental data are compared with various models of EAS development. (auth)

16747 (CONF-730804-P4, pp 2384-2388) EAS CHERENKOV LIGHT FLUX AT CORE DISTANCE 300 TO 500 M AT SEA LEVEL AND THE ENERGY OF SHOWER PRIMARIES. Dyakonov, M. N. (Inst. of Comophysical Research, Yakutsk, USSR); Kolosov, V. A.; Krasilnikov, D. D.; Kulakovskaya, V. P.; Lischenjuk, F. F.; Orlov, V. A.; Sleptsov, I. Y.; Nikolskii, S. I. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

It is found that the EAS Cherenkov light flux which arrives from atmosphere at core distances 300 to 500 m at sea level at primary energies $>10^{16}$ eV does not depend on EAS development model with accuracy ±20 per cent but it only depends (almost linearly) on primary energy, i.e., it is the most important EAS energy parameter. Using this stated property of EAS Cherenkov flux the transform coefficients from sea level shower particle number to energy of shower primary are found. These coefficients are significantly higher (~2–2.5 times) than those obtained according to shower development models usually discussed and used in the cosmic ray energy spectrum estimations at energies above 10^{17} eV. (auth)

16748 (CONF-730804-P4, pp 2389-2392) RESULTS OF THE FIRST STAGE OBSERVATIONS AT THE YAKUTSK EAS COMPLEX ARRAY. II. The Lateral Distribution of EAS Cherenkov Light of Large Sizes at Sea Level. Dyakonov, M. N. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR); Knurenko, S. P.; Kolosov, V. A. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The observed lateral distributions of EAS Cherenkov light flux densities at core distances 150 to 700 m for the different shower sizes 10^7 to $3 \cdot 10^8$ particles at sea level are presented. (auth)

16749 (CONF-730804-P4, pp 2393-2397) COSMIC-RAY ENERGY SPECTRUM AT ENERGIES ABOVE 10^{17} eV. Krasilnikov, D. D. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The integral energy spectrum of primary cosmic rays in the energy range 10^{17} to 10^{19} eV is described by a power law with a single exponent: $I(>E_0) = (3.5 \pm 0.5) \cdot 10^{-12} (E_0/10^{18})^{-1.92 \pm 0.07}$ $m^{-2}s^{-1}sr^{-1}$. (auth)

16750 (CONF-730804-P4, pp 2399-2406) INVESTIGATION OF RADIOEMISSION FROM EAS WITH THE FREQUENCIES 32, 58, AND 2MHz. Atrashkevich, V. B. (Moscow State Univ.); Vedeneev, O. V.; Prosin, V. V. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The results of investigation of radio emission from EAS at the frequencies of 32 MHz and 58 MHz at the MSU array are reported. The geomagnetic mechanism of the radio-emission generation is realized in most cases. The radio emission lateral distribution form correlates with shower parameters S and N_μ/N_e. The fluctuations of radio emission field strength normalized to sin (v,H) = 1 and $N_\mu = 5 \times 10^5$ are more than an order of a value in the flat region of lateral distribution function. At the same distances the radio emission field strength is connected with total muon number at $E \sim N_\mu^{0.8}$. The ratio of field strength at the frequencies of 58 MHz and 32 MHz is close to 1 at the distance from 50 m to 150 m from a shower axis, although it fluctuates by 3 times from one shower to another. (auth)

16751 (CONF-730804-P4, pp 2407-2413) FLUCTUATIONS IN THE LONGITUDINAL DEVELOPMENT OF EAS STUDIED BY MEANS OF THEIR RADIO EMISSION. Allan, H. R. (Imperial College, London); Shutie, P. F.; Sun, M. P.; Jones, J. K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The lateral distribution of the radio emission at 60 MHz has been measured for approximately 100 showers of energy $\geq 10^{17}$ eV. The theory of the emission has been extended, confirming that the most important single parameter controlling the shape of the lateral distribution is the distance between the receiving array and the shower maximum. It is found that, on average, the shower maximum is further from the receiving array for showers with large zenith angles, the shift corresponding quantitatively to the increased atmospheric thickness for non-vertical showers. However, individual showers may differ considerably from the average. For showers of the same energy and zenith angle, the position of the shower maximum appears to fluctuate by more than 100 g/cm^{-2} about its average position. (auth)

16752 (CONF-730804-P4, pp 2414-2419) RADIO PULSES AT 46, 65, AND 110 MHz FROM EAS. Mandolesi, N.; Morigi, G.;

Palumbo, G.G.C. (Consiglio Nazionale dell Ricerche, Bologna). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

An array of 5 plastic scintillators detecting Air Showers of average size 10^6 particles has been operating in coincidence with 3 antenna arrays. The lateral distribution of ratio pulses from Extensive Air Showers (EAS) has been obtained at 45, 65 and 110 MHz. At all frequencies the lateral distribution steepens quite rapidly with increasing distance from the shower core and more so at higher frequencies. A large spread of the experimental points seems to indicate fluctuations in the height of shower maximum. A frequency spectrum has been obtained from the data, for showers with core distances $75 < R < 105$ m it presents a maximum at 65 MHz. At smaller distances it seems to increase. (auth)

16753 (CONF-730804-P4, pp 2420-2425) LOW-FREQUENCY RADIO SIGNALS FROM EXTENSIVE AIR SHOWERS. Clay, R. W.; Crouch, P. C.; Gregory, A. G.; Prescott, J. R. (Univ. of Adelaide). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

At frequencies below 10 MHz there is conflict between theoretical estimates and measurements of the field strength of radio pulses associated with extensive air showers. A series of measurements has been made at 100 kHz which shows a large average signal to noise ratio, with correspondingly large field strength, and a very marked variation of signal strength with time. It is argued that the signals observed may be due to modification of the atmospheric electric potential gradient by the ionization of the shower. (auth)

16754 (CONF-730804-P4, pp 2427-2432) SPECTRAL DISTRIBUTION EAS RADIO-FREQUENCY RADIATION STUDY. Volovik, V. D.; Zalyubovskii, I. I.; Levchenko, V. N.; Samburova, S. I.; Sogokon, A. B.; Hirnuy, A. I.; Shmatko, E. S. (Kharkov State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A new installation for the form of spectral distribution radiofrequency radiation study near EAS axis is described. With the help of two scintillation detectors the showers with particles numbering more than 10^5 are registered. EAS axis trace position on the observation level and full number of particles is measured with Geiger hodoscope with pulse high-voltage feeding. Spectral distribution of radio-frequency radiation is investigated with conical two-arm spiral antenna. Measurements are conducted at frequencies 32, 49, 51, 60, 80, 120, 162 mcps and permit to make some conclusions about EAS radiofrequency radiation origin. (auth)

16755 (CONF-730804-P4, pp 2434-2437) DECREASE OF RADIATION LENGTH IN AIR DUE TO MOLECULAR BINDING. Genannt, R.; Pilkuhn, H. (Univ. of Karlsruhe, Ger.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The radiation length in air is computed as 34.6 g cm^{-2}. (auth)

16756 (CONF-730804-P4, pp 2438-2442) MODELS OF EAS DEVELOPMENT AND THE SIZE SPECTRUM OF EAS AT VARIOUS ATMOSPHERIC DEPTHS. Sivaprasad, K.; Srinivasa Rao, M. V. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Using the results of Monte Carlo calculations of EAS propagation through the atmosphere based on some nuclear interaction models and different assumed primary cosmic ray spectra the size spectrum of EAS at various atmospheric depths was derived. A comparison of the expected spectrum with the observed was made, and conclusions regarding the nature of the primary spectrum and nuclear interactions were drawn. (auth)

16757 (CONF-730804-P4, pp 2444-2448) FLUCTUATIONS OF MUON STRUCTURE FUNCTION IN EXTENSIVE AIR SHOWERS IN THE ENERGY RANGE 10^{17} TO 10^{21} eV. Dedenko, L. G.; Dimova, I. A. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The muon density fluctuations which were calculated taking into account all kinds of scattering effects are minimal at core distances of 600 + 900 m, where the relative standard deviation $(\delta/\langle\rho\rangle)$ is about 5 + 10% for showers incident at zenith angle $\varphi = 60°$ and minimal inside the circle with the radius of 250 m, where the relative standard deviation is about 15-18% for vertically incident showers. At large core distances the relative standard deviation increase up to 40 + 80%. In individual showers muon density can fluctuate as much as nearly two orders of the magnitude at 2000-2500 m from the core. (auth)

16758 (CONF-730804-P4, pp 2449-2454) CASCADING OF COSMIC-RAY NUCLEI IN THE ATMOSPHERE. Waddington, C. J. (Imperial College of Science and Tech., London); Freier, P. S. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The problem of the development and of the fluctuations that occur in the cascade of nucleons and nuclei produced when energetic cosmic ray nuclei traverse the atmosphere, was approached in a new manner particularly relevant to the problem of the generation of extensive air showers (EAS) by these nuclei. By combining new data with those available in the literature detailed characteristics of nearly 2300 nucleon interactions produced by energetic, $E \geq 1$ GeV/n, nuclei in either nuclear emulsion or carbon were obtained. Rather more than 1000 of these can be regarded as interactions with air-like nuclei. These data were used in a Monte Carlo simulation of the nuclear cascades produced by iron and silicon nuclei traversing the atmosphere by allowing the characteristics of a specific interaction selected at random to determine the development of the cascade. This approach allows one to study not only the mean behavior, but also the fluctuations. This should allow a more realistic modelling of the fluctuations in EAS than hitherto and hence assist in an evaluation of the composition of the primary nuclei in this high energy region. (auth)

16759 (CONF-730804-P4, pp 2455-2460) SPATIAL AND ANGULAR DISTRIBUTION OF CASCADE PARTICLES NEAR SHOWER AXIS. Guzhavin, V. V.; Ivanenko, I. P.; Roganova, T. M. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

An approximate formula for the angular-lateral distribution function of the cascade electrons is used to estimate the accuracy of measurements of the electron-photon cascade energies, E_0, on the basis of the core approximation method. (auth)

16760 (CONF-730804-P4, pp 2461-2466) FLUCTUATIONS IN THE ANGULAR DISTRIBUTION OF ELECTRONS IN ELECTROMAGNETIC CASCADES TO THE CORE APPROXIMATION. Bakhtadze, A. K.; Gerasimova, N. M. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Estimate of fluctuations in the angular distribution of shower is very important when analyzing the data on angular structure of electromagnetic showers. An analytical expression for the dispersion of the electron angular distribution to the core approximation is derived. (auth)

16761 (CONF-730804-P4, pp 2467-2472) EFFECT OF $N\bar{N}$-PRODUCTION ON PARTICLE SPECTRA IN VERTICALLY INCIDENT AND INCLINED SHOWERS DERIVED FROM SIMULATIONS. Grieder, P. K. F. (Univ. of Bern). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A detailed analysis has been carried out to study the extent to which nucleon-antinucleon production affects the propagation characteristics, the energy spectra, lateral density, and delay distributions of air shower particles for vertically incident proton initiated showers, in the primary energy range from 10^4 to 10^7 GeV, using different interaction models. The zenith angle dependence of some of the significant observable quantities of air showers, such as particle ratios, energy spectra and others have been investigated in a series of simulation calculations for 10^6 GeV proton initiated showers. The calculations were carried out for a distinct high energy interaction model, whose properties have been well established before under vertical incidence. The results are discussed and compared with experimental data. Some typical spectra are shown. (auth)

16762 (CONF-730804-P4, pp 2473-2488) COMPUTER SIMULATIONS OF AIR SHOWERS. Dixon, H. E.; Earnshaw, J. C.; Hook, J. R.; Smith, G. J.; Turver, K. E. (Univ. of Durham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A selection of information on EAS including data appropriate

to primary cosmic rays in a wide range of energy, together with brief comments on the problem of determining the nature of the primaries is presented. (auth)

16763 (CONF-730804-P4, pp 2489-2492) ELECTRON DENSITY SPECTRUM OF EXTENSIVE AIR SHOWERS AT SEA LEVEL. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The electron density spectrum of EAS at sea level was measured in order to check the results of previous work which indicate that there is a possible anomalous change in slope for densities >1,000m^{-2}. If the integral density spectrum is represented by $N(>\Delta) = K\Delta^{-\gamma}$ our present results are consistent with $\gamma = 1.5$ for $\Delta < 1{,}000\text{m}^{-2}$ and $\gamma = 2.0$ for $\Delta > 1{,}000\text{m}^{-2}$. (auth)

16764 (CONF-730804-P4, pp 2493-2494) HYPOTHESIS OF DUST GRAIN ORIGIN OF COSMIC-RAY AIR SHOWERS. Berezinskii, V. S.; Prilutskii, O. F. (Inst. of Nuclear Research, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

It is shown that relativistic and subrelativistic dust grains obtain large electric charge as a result of the interaction with photons and interstellar gas atoms. The developing electrostatic forces break the grain. The relativistic dust grains break effectively within the solar system and therefore can not originate the observed extensive air showers. (auth)

16765 (CONF-730804-P4, pp 2495-2499) ESTIMATION OF THE PRIMARY COSMIC RAYS–MEAN MASS ON THE BASIS OF EAS PARAMETERS FLUCTUATIONS. Catz, Ph.; Hochart, J. P.; Maze, R.; Zawadzki, A.; Gawin, J.; Wdowczyk, J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

It is shown that fluctuations of the shower age parameter are relatively wide. From theoretical calculations it follows that such fluctuations can be obtained only if in the primary flux dominate protons. Consequences of those observations for the picture of high energy interactions are discussed and conclusions are drawn about the necessity of relatively fast increase of the produced particles multiplicity.((auth)

16766 (CONF-730804-P4, pp 2500-2505) HIGH-ENERGY MUONS OF EAS. Erlykin, A. D.; Kulichenko, A. K.; Machavariani, S. K. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Energy spectrum of muons in EAS with $N_s > 3.10^4$ and EAS accompaniment of muons with energy above 0.5 TeV was studied. Results were compared with calculations to check models of high energy interactions, particularly, the high multiplicity model, and were used to analyze the chemical composition of primary cosmic rays in the region above 10 TeV. (auth)

16767 (CONF-730804-P4, pp 2507-2512) RESULTS OF THE FIRST STAGE OBSERVATIONS AT THE YAKUTSK EAS COMPLEX ARRAY. I. The Lateral Distribution and EAS Size Spectrum at Sea Level. Kerschenholz, I. M. (Inst. of Cosmophysical Research, Yakutsk); Krasilnikov, D. D.; Kuzmin, A. I. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The lateral distribution of EAS particle densities observed at sea level in unshielded scintillation counters of 5 cm thickness at the core distances 200-700m for showers of different sizes are considered. The differential and integral EAS size spectra in the range $10^7 - 10^8$ particles at sea level are presented. (auth)

16768 (CONF-730804-P4, pp 2513-2517) PRIMARY ENERGY SPECTRUM ABOVE 10^{17}eV. Edge, D. M.; Garmston, H. J.; Reid, R. J. O.; Watson, A. A.; Wilson, J. G.; Wray, A. M. (Univ. of Leeds, UK). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The integral energy spectrum for primaries of $3.10^{17} < E_p < 5.10^{19}$ eV is: $(I(>E_p) = (4.5 \pm 0.5) \times 10^{-10}(E_p/10^{17})^{-2.17 \pm 0.03}$ m^{-2} s^{-1} sr^{-1}, where most of the uncertainty in intensity (as opposed to slope) arises because of lack of knowledge about the nuclear physics of shower development. This value is not significantly changed by the determination of variation of the lateral distribution function of the shower parameter $\rho(r)$ reported. There is no evidence of any cut-off or flattening of the spectrum at energies $< 10^{20}$eV. (auth)

16769 (CONF-730804-P4, pp 2519-2524) UPPER END OF THE OBSERVED COSMIC-RAY ENERGY SPECTRUM. Bell, C. J.; Bray, A. D.; Denehy, B. V. (Cornell-Sydney Univ., Ithaca, NY). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Results from the 54 km^2 array in the Pilliga State Forest for the period January 1968 to October 1972 are used to derive the cosmic ray energy spectrum from about 10^{17}eV to about 10^{20}eV. For this period and using this estimate, about 40 events with $E_p > 10^{19}$ and zenith angle < 50° were obtained. For a given total number of muons in a shower the estimate of the primary energy is less than that of most other workers in this field by a factor of ~2. (auth)

16770 (CONF-730804-P4, pp 2525-2528) ARRIVAL DIRECTIONS OF LARGE EAS. Bell, C. J.; Bray, A. D.; Denehy, B. V. (Cornell Univ., Ithaca, NY). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The arrival directions of 9047 air showers of energy > ~10^{17}eV and zenith angle < 60° have been recorded. The sample includes about 50 events with $E_p > 1.5 \times 10^{19}$eV. (auth)

16771 (CONF-730804-P4, pp 2530-2533) ARRIVAL DIRECTIONS OF HIGH-ENERGY EAS. Brownlee, R. G.; Edge, D. M.; Garmston, H. J.; Lapikens, J.; Reid, R. J. O.; Watson, A. A.; Wild, P. (Univ. of Leeds, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Work reported at the Hobart Conference on the arrival directions of very large showers has been extended at energies > 10^{19}eV. No significant anisotropy has been found and revised upper limits to any anisotropy are given. The direction of the possible source in the region of the pulsar, CPO950, pointed out by the Sydney group (Bell et al. 1971) has been examined. No excess in this direction is found, nor is there any correlation with the directions of other pulsars. At high energies ($E_p > 5.10^{19}$eV) some showers are observed to arrive almost perpendicular to the galactic plane and must be extragalactic. (auth)

16772 (CONF-730804-P4, pp 2534-2538) SOME MEAN CHARACTERISTICS OF MUON COMPONENT IN EXTENSIVE AIR SHOWERS AT 3340 m.a.s.l. Kabanova, N. V.; Stamenov, J. N.; Janminchev, V. D. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

At Tien Shan complex installation the two-53 m^2 and 25 m^2 effective area hodoscope detectors have been used to investigate the flux of muon component of EAS with $E_\mu \geq 5$ GeV and $E_\mu \geq 0.5$ GeV respectively. The mean lateral distribution of muons with $E_\mu \geq 5$ GeV at the core distances 8-60 m by form $\rho_\mu \sim \gamma_\mu^{-n}$, n = (0.94 ± 0.07) was measured, and its correlation with the age parameter S was studied. The relation between number of muons and total number of particles of EAS was investigated. (auth)

16773 (CONF-730804-P4, pp 2539-2544) DENSITY DISTRIBUTION OF THE MUON AND ELECTRON COMPONENTS OF NEAR VERTICAL EAS. Armitage, M. L.; Blake, P. R.; Nash, W. F. (Univ. of Nottingham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A 12m^2 neon flash-tube detector has been operated at the center of the Haverah Park EAS array. The detector enables measurements to be made of the total charged particle and muon densities of EAS triggering the array. From 1000 showers with zenith angle < 25° the muon and charged particle lateral density distributions were determined in the core distance range 150m < R < 1.5km. Measurements are compared with the experimental results from other workers and EAS model simulations. (auth)

16774 (CONF-730804-P4, pp 2545-2550) TIME DISTRIBUTION OF MUONS IN EAS. Armitage, M. L.; Blake, P. R.; Nash, W. F. (Univ. of Nottingham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The arrival time distribution of 4,700 EAS muons has been

measured using a 10 m^2 liquid scintillator positioned at the center of the Haverah Park EAS array. The arrival time of the muons has been measured relative to the first detected signal in the neighboring 34 m^2 water Cherenkov detector. The arrival time distribution of muons is shown to be a function of core distance and zenith angle. The results are compared with model calculations. (auth)

16775 (CONF-730804-P, pp 2551-2555) STUDIES OF EAS AS A FUNCTION OF ZENITH ANGLE. Armitage, M. L.; Blake, P. R.; Nash, W. F. (Univ. of Nottingham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A 12m^2 neon flash-tube detector operates at the center of the Haverah Park array and has been used to measure the total charged particle content and muon content of EAS. The lateral density distribution of the total charged particle content and the muon content have been measured as a function of zenith angle in the core distance interval 150m < R < 100m. The results are compared with EAS simulations. The total charged particle to muon density ratio has been investigated as a function of zenith angle. (auth)

16776 (CONF-730804-P4, pp 2556-2561) RECENT MEASUREMENTS OF THE MUON COMPONENT OF LARGE AIR SHOWERS AT HAVERAH PARK. Dixon, H. E.; Machin, A. C.; Pickersgill, D. R.; Smith, G. J.; Turver, K. E. (Univ. of Durham, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

During 1970 the magnet spectrograph was modified to have a higher momentum resolution; the data from 2.5 years of operation of the modified spectrograph (to be referred to as the Mark II spectrograph) are reported. The measurement of prime concern to date has been the determination of the density of distant energetic muons for comparison with the earlier data; it has also been possible with the visual detectors of the Mark II spectrograph to measure accurately the lateral distribution function for muons of momentum greater than 1 GeV/c at distances as small as 30m from the core in showers initiated by 10^{17} eV primary particles and incident at zenith angles less than 30°. (auth)

16777 (CONF-730804-P4, pp 2562-2567) CHARACTERS OF AIR SHOWERS OF ENERGIES ABOVE 10^{17} eV OBSERVED AT SEA LEVEL. Kawaguchi, S. (Tokyo Univ.); Suga, K.; Sakuyama, H. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The observation of air showers of energies above 10^{17} eV by the simultaneous operation of the Institute for Nuclear Study (INS) AS array and the INS LAS array has been continued. Among the experimental results so far obtained, the preliminary version of the lateral distribution for air showers with sizes $1 \times 10^7 - 5 \times 10^7$ is described. (auth)

16778 (CONF-730804-P4, pp 2569-2574) STRUCTURE FUNCTIONS OF VERY LARGE EAS. Bell, C. J.; Bray, A. D.; Denehy, B. V.; Goorevich, L. (Cornell-Sydney Univ., Ithaca, NY). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Shielded and unshielded spark chambers of high multiple particle efficiency have been operated in conjunction with the Sydney 54 km^2 air shower array (SUGAR). Measurements of the structure functions of both the muons and charged particle (electron + muon) structure functions were made in showers of muon size (N_μ) 5×10^5 to 1.3×10^8, and at core distances from 25m to 1.6 km. (auth)

16779 (CONF-730804-P4, pp 2576-2581) CURVATURES OF AIR SHOWER FRONTS AT SIZES 3×10^7 TO 3×10^9 OBSERVED AT CHACALTAYA (5200 m.a.s.l.). Aguirre, C. (Laboratorio de Fisica Cosmica, Bolivia); Mackeown, P. K.; Mejia, G. R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Results of measurements of the radius of curvature of the fast particle front of extensive air showers of sizes larger than 3×10^7 and age about 0.8 at 5,200 m altitude are presented and discussed. (auth)

16780 (CONF-730804-P4, pp 2582-2587) RELATION OF LONGITUDINAL DEVELOPMENT TO SHOWER-FRONT STRUCTURE. Lapikens, J.; Watson, A. A.; Wild, P.; Wilson, J. G. (Univ. of Leeds, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Preliminary studies of pulse profiles of Haverah Park detectors, as these reflect the time sequence of arrival of particles, demonstrate the existence of difference characteristic of individual showers. For one particularly marked example, where slow pulse profiles indicate important late shower development, concurrent data on the lateral distribution of the Haverah Park $\rho(r)$ function shows a strong abnormality consistent with the conclusion reached from the profile measurements. While this event exhibits the type of fluctuation anticipated for a proton primary, much more material is required before meaningful estimates of the proportion of protons become possible. (auth)

16781 (CONF-730804-P4, pp 2588-2591) RESULTS OF THE FIRST STAGE OBSERVATIONS AT THE YAKUTSK EAS COMPLEX ARRAY. III. Zenith Angle EAS Distribution With Sizes Approx. 10^8 Particles at Sea Level and the Strongly Inclined Events of Large Sizes. Kozlov, V. I. (Inst. of Cosmophysical Research, Yakutsk, USSR); Krasilnikov, D. D.; Kuzmin, A. I. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The observed zenith angle distribution of shower arriving directions for EAS of size ~10^8 particles at sea level is the same as for the showers of number ~10^5 particles. This is evidence of faster shower development at primary energies above 10^{17}eV than that is assumed by usual models of inelastic hadron collisions at energies above 10^{15}eV. Two EAS events arrived at zenith angles 75° are described. The number of shower particles at sea level in one of these events is 3.10^8 particles and in the other one it is $>10^7$. (auth)

16782 (CONF-730804-P4, pp 2592-2597) LATERAL DISTRIBUTIONS OF ELECTRONS AND MUONS IN LARGE AIR SHOWERS OBSERVED AT CHACALTAYA (5200 m.a.s.l.). Aquirre, C.; Mackeown, P. K.; Mejia, G. R. (Laboratorio de Fisci ca Comica, San Andres, Bolivia). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Details of experimental arrangement and analysis method of the large air shower experiment at Mt. Chacaltaya are described. Results of lateral distributions of electrons and muons, and the muon-electron ratio show that the average shower age is almost constant 0.7 ~ 0.8 over the size range 3×10^7 to 3×10^9, and zenith angle range 0° to 60°. (auth)

16783 (CONF-730804-P4, pp 2599-2603) INVESTIGATION OF EAS WITH PRIMARY ENERGIES LESS THAN 10^{15}EV. Asetkin, V. S.; Danilova, T. V.; Nesterova, N. M.; Nikolskii, S. I.; Stamenov, I. N.; Tukish, E. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The electron and muon components of showers with primary energies from 10^{13} eV to 10^{15} eV have been investigated, at mountain level (700 g/cm^2). The lateral density distributions of electrons and muons with energies above 5 GeV have been measured at distances from shower core 3-70 m for electrons and 5-50 m for muons. The function of the lateral muon density distribution shows the dependence on the primary energy. The size dependence of the muon number is presented. (auth)

16784 (CONF-730804-P4, pp 2605-2609) MUONS IN EXTENSIVE AIR SHOWERS. Firkowski, R.; Grochalska, B.; Olejniczak, W.; Wdowczyk, J. (Univ. of Lodz, Poland). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The Lodz EAS array has been used to measure the lateral distribution of muons of energy above 5 GeV and the density spectrum of muon showers for the same energy threshold. The results suggest rapid development of EAS in upper part of atmosphere. Most likely the effect is due to high multiplicity of secondary particle production in extremely high energy interactions since the observed fluctuations indicate that an important role is played by protons in the primary flux. (auth)

16785 (CONF-730804-P4, pp 2610-2615) CHARACTERISTICS OF EXTENSIVE AIR SHOWERS SELECTED BY A LOCAL ELECTRON DENSITY DETECTOR. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The distribution of shower size and core distance has been calculated for E.A.S. which produce local electron densities of $>40m^{-2}$ and $>160m^{-2}$ respectively. The calculations are checked using measurements of the density spectrum of muons in such showers. (auth)

16786 (CONF-730804-P4, pp 2617-2624) ULTRA-HIGH ENERGY INTERACTIONS AND THE ENERGY CALIBRATION OF GIANT AIR SHOWER ARRAYS. Goorevich, L.; Peak, L. S. (Univ. of Sydney). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A model of ultra-high energy interactions is formulated incorporating the latest experimental results for nucleon-nucleon and π-nucleon collisions. This model is then used to set up analytical diffusion equations describing the generation of giant air showers. The total numbers of nuclear active particles, muons and electrons as a function of depth and primary energy are predicted, and these predictions are compared with experiment. An average transverse momentum is assigned to the muons by examination of experimental radial distributions. (auth)

16787 (CONF-730804-P4, pp 2625-2632) TRENDS IN THE ENERGY DEPENDENCE OF STRONG INTERACTION CHARACTERISTICS AT ULTRA HIGH ENERGIES. Vatcha, R. H.; Streekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

It is shown that certain "anomalous" properties of EAS, especially size dependence of the high energy hadronic component cannot be consistently accounted for in terms of a change in the primary composition alone. Rather drastic changes in strong interaction characteristics with energy are suggested and their trends are indicated. (auth)

16788 (CONF-730804-P4, pp 2633-2638) EXTENSIVE AIR SHOWERS AND CHARACTERISTICS OF NUCLEAR INTERACTIONS AT SUPERHIGH ENERGIES. Kalmykov, N. N.; Fomin, Yu. A.; Khristiansen, G. B. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A model of EAS development implying a pronounced increase of the secondary particle multiplicity in the 10^{13}-10^{14} eV energy range and permitting the agreement with experiment to be improved is analyzed against the conventional EAS model which fails to satisfactorily describe some EAS characteristics (particularly, altitude variation). The proposed model is shown to agree with the experimental N_μ-N_e relation. Experiments which would help to specify the EAS development model are discussed. (auth)

16789 (CONF-730804-P4, pp 2645-2651) NUCLEAR EFFECT AND EXTENSIVE AIR SHOWER PROPERTIES. Mikamo, S. (Tokyo Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

To make clear the properties of extensive air showers possible nuclear effects on the interaction characteristics of hadron-nucleus collisions are investigated with the use of accelerator data. Approximate bounds of the nuclear effect on the energy spectra, multiplicity, inelasticity and the behavior of transverse momentum are explicitly presented. (auth)

16790 (CONF-730804-P4, pp 2652-2657) COSMIC-RAY AIR SHOWERS AND FEYNMAN SCALING ABOVE 1000 GeV. Gaisser, T. K.; Maurer, R. H.; Noble, C. J. (Bartol Research Foundation, Swarthmore, PA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A method is described for using extensive air shower data to determine whether a Feynman scaling limit exists in the central region for inclusive cross sections. Preliminary analysis using ISR data on nucleon-nucleon inclusive cross sections to calculate shower properties indicates that the shower muon to electron ratio is greater than that predicted by the scaling model. In this contribution the facts that the targets are air nuclei instead of nucleons, that the total inelastic cross section increases with energy, and that a significant portion of heavy primaries may be present at air shower energies are taken into account individually. Discussion of calculations done with the CKP and Landau models is also included. (auth)

16791 (CONF-730804-P4, pp 2659-2664) ENERGY OF EXTENSIVE AIR SHOWER CORES. Aseikin, V. S.; Chubenko, A. P.; Nesterova, N. M.; Nikolskii, S. I.; Tukish, E. I.; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The energy flows of electron-photon and hadron components in the shower cores were studied by means of the calorimeter of the Tien-Shan complex installation. Preliminary data point out that in EAS of the size $N \approx 10^5$-10^6 the average energy of electron-photon and hadron component of the shower cores 10 times more in the young showers than in the old showers. (auth)

16792 (CONF-730804-P4, pp 2665-2670) EXTENSIVE AIR SHOWER CORE STRUCTURE AND LARGE TRANSVERSE MOMENTA OF NUCLEAR INTERACTION. Nesterov, N. M.; Romakhin, V. A.; Bobova, V. P. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The energy of nuclear-active particles (n.a.p.).En.a.p. and distances between the n.a.p. jet and the shower core Δr, also between several jet in the same shower were measured by the ionization calorimeter and scintillation counters in showers with $Ne \geq 10^6$ at 3340 m a.s.l. The distribution of E n.a.p. $\Delta r \sim P_\perp$ ch ($P_\perp$ - is a transverse momentum, h - is an interaction height above observed level was investigated. The comparison of experimental data with calculations shows the existence of anomalous transverse momenta in the hadron interaction at $E_{n.a.p.} \geq 10^{15}$ eV. (auth)

16793 (CONF-730804-P4, pp 2671-2675) AIR SHOWER CORES OBSERVED BY CHACALTAYA EMULSION CHAMBER. Lattes, C. M. G.; Mantovani, M. S. M.; Santos, C. (Univ. Tokyo). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Description is given on the event called "Centauro", a large family of nuclear active particles observed in Chacaltaya emulsion chamber no. 15. Analysis shows that it is an example of multiple production of more than fifty nucleons in the atmosphere ~50 m above the chamber. Data are consistent with nucleon emission from a giant fire-ball of mass ≥ 100 GeV. (auth)

16794 (CONF-730804-P4, pp 2676-2681) HADRON COMPONENT IN EAS AT MOUNTAIN ALTITUDE. van Staa, R.; Aschenbach, B.; Boehm, E. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Investigations on the hadron component in EAS have been performed at the Pic du Midi (730 g/cm^2) in France. The equipment consists of an air shower array, completed by a special high energy hadron detector and a neutron monitor to detect the nuclear active component of low energy. Energy spectra and lateral distributions of hadrons with $E > 100$ GeV are reported and compared with Monte Carlo calculations. Conclusions on the multiplicity and the mean transverse momentum are drawn. Preliminary results on the low energy hadron component are presented. (auth)

16795 (CONF-730804-P4, pp 2688-2693) EAS CORES AND HIGH ENERGY γ RAYS. Dake, S. (Kobe Univ., Japan); Hazama, M.; Nakanishi, Y.; Nishikawa, K.; Sakata, M.; Yamamoto, Y.; Hatano, Y.; Jitsuno, K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A total of 45 events of high energy γ rays (≥ 0.5 TeV) detected in an emulsion chamber have been identified with EAS events triggered by bursts under the emulsion chamber. It is found that the high energy γ rays are associated with EAS of various sizes of $10^4 \sim 10^7$. Some features of EAS triggered by bursts are also found. (auth)

16796 (CONF-730804-P4, pp 2703-2708) NEUTRON CONTRIBUTION TO X-RAY PHOTON PRODUCTION IN STRATOSPHERE. Kvashnin, A. N.; Charakhchyan, T. N. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The values of the flux and energy spectrum of the photons ($E\gamma > 20$ keV) produced during the 1 to 7 MeV γ-quantum passage

through the atmosphere have been calculated using the Monte-Carlo method. Nuclear reactions of thermal and fast neutrons in air are the source of such γ quanta. The calculations were based on the experimental data about stratospheric neutrons at a 53°N latitude. The photon flux ($E\gamma > 20$ keV) at a depth of 100 g/cm^2 was found to be 2.86 cm^{-2} sec^{-1} in 1965. The number of bursts in the NaI (Tl) crystals of 20 × 20 mm and 40 × 40 mm size from the neutron interaction with the crystal substance was estimated to be 0.8 and 0.7 sec^{-1} in the first and second crystals respectively. The contribution of the photons produced by neutrons to the total number of the bursts in the crystal was found to be 6% while the contribution from the cascade photons was 82%. (auth)

16797 (CONF-730804-P4, pp 2780-2785) DETERMINATION OF THE POINT OF JET INTERACTION BY BACKWARDS EXTRAPOLATION OF THE OBSERVED SECONDARIES. Thompson, R. W. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

In ultra-high energy cosmic ray hadron interaction studies, the point of interaction or vertex may not be directly observed and hence must be inferred from extrapolation of the primaries and secondaries, perhaps in highly nonuniform fields. Two methods for locating the vertex are discussed: 1. "Three Dimensional Least Squares" Method, 2. "Mean Pairwise Track" Method. This work applies to many accelerator experiments. (auth)

16798 (CONF-730804-P4, pp 2861-2866) COMPARISON OF COSMIC-RAY AND ARTIFICIAL TRACKS OF Fe IONS IN EXTRATERRESTRIAL SAMPLES. Plieninger, T.; Kraetschmer, W.; Gentner, W. (Max-Planck-Institut fuer Kernphysik, Heidelberg). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

In order to make charge assignments to VH cosmic-ray ion tracks more reliable, pyroxene crystals from Apollo 11 lunar sample 10047, 13 were irradiated with 9.6 MeV/n Fe ions at the Linac of the University of Manchester (England). The lengths of artificial Fe and preexisting galactic cosmic-ray tracks within the same crystals were compared. By this, a direct comparison is possible without referring to etchable ranges, which were found to be difficult to reveal by etching. Under the chosen etching conditions, the length distributions of artificial Fe and galactic cosmic-ray tracks coincide at a peak centered at about 16 to 18 μ. Annealing effects have shortened the mean length of galactic Fe tracks by about 0.5 μ. Additional peaks at 6 μ and 12 μ were ascribed to Ca and Cr cosmic-ray ions. The abundance ratio (V + Cr + Mn)/Fe in the pyroxenes was found to increase with shielding depth. A primary ratio (V + Cr + Mn)/Fe = 0.73 ± 0.20 for the energy range 300 to 600 MeV/N can be derived. This ratio averaged over the last 10^8 years is higher than the present day ratio by a factor of about 2. The existence of a compositional variation can also be inferred from track data obtained in pyroxenes from the lunar fines. (auth)

16799 (CONF-730804-P4, pp 2867-2871) TECHNIQUES FOR IDENTIFICATION OF VH IONS FROM THEIR ETCHABLE TRACKS IN MINERALS. Kraetschmer, W.; Plieninger, T.; Gentner, W. (Max-Planck Institut fuer Kernphysik, Heidelberg). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

In order to develop techniques for VH ion identification from their etchable tracks in minerals, feldspars and pyroxenes were exposed to artificially accelerated 9.6 MeV/N Ar, Fe, and Cu ions. Studying the artificially produced tracks, it was found for pyroxenes that the lengths of tracks etched for a sufficiently long time can be regarded as a measure of the atomic number of the track forming ion. By measuring the track etching rate as a function of residual range, a significant improvement of the resolution was achieved. The results indicate that with pyroxene detectors even the isotopes of Fe respectively Cu can be resolved. (auth)

16800 (CONF-730804-P4, pp 2959-2963) SPHERICAL HARMONIC ANALYSIS OF SATELLITE ANISOTROPY MEASUREMENTS. Sanderson, T. R.; Page, D. E. (European Space Research and Tech., Noordwijk, Holland). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A method is described whereby a particle distribution measured by a detector telescope mounted upon a spinning satellite can be resolved into a set of spherical harmonics. The response of the telescope to each term in the expansion is determined using a complete 3-dimensional analysis technique. Subsequent fitting of the data from a satellite enables the magnitudes and directions of the first and second harmonics to be found. The effects of sectoring are introduced using the same method, and some limitations of the sectoring technique, with regard to angular resolution, are pointed out. (auth)

16801 (CONF-730804-P4, pp 2993-2996) LATERAL SPREAD OF BURSTS PRODUCED BY MUONS AND NUCLEAR-ACTIVE PARTICLES EMERGING FROM THICK TARGETS AS MEASURED USING NEON FLASH TUBES. Ashton, F.; Coats, R. B.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J.; Smith, N. I. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic-ray conference. Vol. 4.

The lateral spread of bursts produced by muons and nuclear active particles emerging from thick (25 cm) steel targets is correlated with the number of burst particles measured using scintillation counters. Using this calibration data, the burst spectrum and hence the energy spectrum of nuclear active particles in EAS have been determined from the lateral spread of bursts emerging from a 15 cm thick steel target incorporated in a flash tube chamber. Preliminary results show the integral energy spectrum of nuclear active particles is of the form $N(>E) \alpha E^{-1.2\pm0.1}$ for $50 < E < 1{,}000$ GeV and the charge to neutral ratio is 7.0 ± 1.7 for nuclear active particles of energy >25 GeV observed in EAS of median shower size $4.5.10^5$ particles. (auth)

16802 (CONF-730804-P4, pp 3000-3002) MULTIPLE SCATTERING AND THE MASS DETERMINATION OF STOPPING COSMIC-RAY PARTICLES USING A FLASH-TUBE CHAMBER. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A simple technique for determining the mass of stopping cosmic ray particles from multiple scattering and residual range measurements is given. The validity of the method is illustrated using measurements on incoherent stopping muons observed in a flash tube chamber. (auth)

16803 (CONF-730804-P4, pp 3005-3007) MEASUREMENTS ON TWO BODY ELASTIC COLLISIONS OBSERVED IN EXTENSIVE AIR SHOWERS USING A FLASH-TUBE CHAMBER. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

Using a flash tube chamber 84 events that are believed to be the elastic scattering of low energy penetrating EAS particles (scattering angle >4°) on protons have been observed in a sample of 12,057 photographs. EAS were selected by a local electron density requirement of >40 m^{-2}. Non relativistic kinematics are used to obtain the apparent mass of the EAS particle and the interpretation of the apparent mass distribution obtained is considered. (auth)

16804 (CONF-730804-P4, pp 3008-3010) DECAY EVENTS OBSERVED IN REGIONS OF EXTENSIVE AIR SHOWERS OF LOCAL ELECTRON DENSITY >40 m^{-2}. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The decay of a number of charged and neutral particles in regions of EAS of local electron density >40 m^{-2} has been observed using a flash tube chamber. An attempt is made to interpret the observations in terms of the properties of known elementary particles. (auth)

16805 (COO-3071-94) OBSERVATION OF A POSSIBLE ANTI-NEUTRINO PULSE OF EXTRATERRESTRIAL ORIGIN. Lande, K.; Bozoki, G.; Frati, W.; Lee, C. K.; Fenyves, E.; Saavedra, O. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 17 May 1974. 10p. Dep. NTIS $4.00.

An unusual event observed during a search for antineutrino bursts of extraterrestrial origin is reported. The experiment employs a deep underground antineutrino burst detector station at a depth of 4400 m.w.e. in the Homestake gold mine in Lead, South Dakota. On Jan. 4, 1974 at 17 hrs. 10 min. 32 sec. GMT an event involving a total of 24 pulses within 3 msec was observed in six of the eight large water Cherenkov counters. (WDM)

16806 (JPRS-62167) COSMIC RADIATION BURST OBSERVED BY THE "KOSMOS-461" ARTIFICIAL EARTH SATELLITE. Mazets, E. P.; Golenetskii, S. V.; Il'inskii, V. N. Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; No. 2, 126-128(1974). 4p. NTIS.

The results of observations of a burst of cosmic gamma radiation on 17 January 1972 are presented. (auth)

16807 (LA-UR-74-833) COSMIC GAMMA-RAY BURSTS: A REVIEW OF THE OBSERVATIONAL DATA. Strong, I. B. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 38p. (CONF-740628-2). Dep. NTIS $5.00.

From ESLAB symposium on the context and status of gamma-ray astronomy; Frascati, Italy (10 Jun 1974).

This paper is intended as a general introduction to the session on transient cosmic x- and gamma-ray sources - gamma bursts. Temporal properties are discussed, including duration, fluctuation, and frequencies. Energy fluxes and spectral properties are described together. The directional data is used to provide estimates of the distance to the sources and the absolute luminosities involved. (auth)

16808 (LA-UR-74-868) FUTURE SATELLITE EXPERIMENTS FOR GAMMA-BURST OBSERVATIONS. Evans, W. D. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 23p. (CONF-740628-1). Dep. NTIS $4.25.

From ESLAB symposium on the context and status of gamma-ray astronomy; Frascati, Italy (10 Jun 1974).

Based on the presently available data certain objectives for future satellite experiments are identified. Methods for achieving these objectives and the requirements they impose on instrument design and program coordination are described. Some of the experiments planned for launch during the next few years are discussed and the extent to which they will satisfy the objectives is considered. (auth)

16809 (NP-20009) INTERACTIONS OF FAST PARTICLES WITH WAVES OF COSMIC MAGNETOACTIVE PLASMA. Tsytovich, V. N. (AN SSSR, Moscow. Fizicheskij Inst.). 1973. 50p. (In Russian). Dep. NTIS (US Sales Only) $5.50.

The general concepts in the interaction of fast particles with waves of magnetoactive plasma are derived. The mechanisms of this reaction are defined. The interaction of fast particles with plasma oscillations is described. Wave instabilities caused by fast particles are considered. The isotropization of cosmic radiation is discussed. The energy spectrum of relativistic particles is determined. (JSR)

16810 (TT-74-50011, pp 197-200) ARGON SPALLATION YIELDS OF COSMOGONIC RADIOISOTOPES. Yasyulenis, R. Yu.; Luyanas, V. Yu.; Styro, B. I. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The evaluation of the rates at which cosmogonic isotopes are formed by argon spallation is examined. The cross sections of isotope formation are calculated from a refined Rudstam formula. The yields are given for one star of ^{18}Fe, ^{24}Ne, ^{22}Na, ^{24}Na, ^{28}Mg, ^{26}Al, ^{29}Al, ^{31}Si, ^{32}Si, ^{30}P, ^{32}P, ^{33}P, ^{37}S, ^{34}Cl, ^{36}Cl, and ^{38}C isotopes. The yield dependence on one star from the depth of the atmosphere is also given. (auth)

16811 MEASUREMENT OF ^{26}Al IN STONE METEORITES AND ITS USE IN THE DERIVATION OF ORBITAL ELEMENTS. Cameron, I. R.; Top, Z. (New Brunswick Univ., Saint John, Canada). Geochim. Cosmochim. Acta; 38: No. 6, 899-909(Jun 1974).

The ^{26}Al activity has been measured by gamma-ray coincidence spectrometry in a total of 30 stony meteorites (13 bronzite, 13 hypersthene, 1 carbonaceous and 1 enstatite chondrite, and 2 achondrites). The measured ^{26}Al content has been compared with calculated values based on the method developed by Lavrukhina and Ustinova (Sov. Phys.-Dokl.; 17: 409 (1972); and Earth Planet. Sci. Lett.; 15: 347 (1972)), which takes account of the modulation of the galactic cosmic-ray intensity along the meteorite orbit due to solar magnetic activity. The predictions have been modified empirically to allow for the difference in chemical composition between H- and L-chondrites. Comparison of the measured value with that predicted in the absence of solar modulation permits the estimation of the aphelion of the orbit of the meteorite. The great majority of the derived aphelia lie within the range 2.05 to 2.45 AU. While this result must be treated with considerable reserve owing to the uncertainties associated with the model, it is consistent with recent data from photometric observations of the asteroid belt. (auth)

16812 PRODUCTION OF GAMMA RADIATION IN DENSE INTERSTELLAR CLOUDS BY COSMIC-RAY INTERACTIONS. Black, J. H. (Harvard Univ., Cambridge, MA); Fazio, G. G. Astrophys. J.; 185: No. 1, L7-L11(1 Oct 1973).

Dense interstellar clouds can be detectable discrete sources of γ rays (>100 MeV) resulting from cosmic-ray interactions with the gas in the cloud, particularly molecular hydrogen. If the distance to the cloud is known, its mass can be determined from the γ-ray intensity. It is proposed that the ρ Oph dust cloud is the γ-ray source near $l^{II} = 352°$, $b^{II} = +16°$ observed by three different groups, and that the γ-ray source Sgr γ-1 is associated with the dense dark cloud in Corona Austrina. The galactic-center cloud complex could contribute to the source of excess γ rays observed in that region. Several other galactic sources are suggested. (auth)

16813 ENERGY SPECTRA OF COSMIC GAMMA-RAY BURSTS. Cline, T. L. (Goddard Space Flight Center, Greenbelt, MD); Desai, U. D.; Klebesadel, R. W.; Strong, I. B. Astrophys. J.; 185: No. 1, L1-L5(1 Oct 1973).

Spectral measurements of six cosmic gamma-ray bursts in the energy region 0.1 to 1.2 MeV, made using a semi-omnidirectional X-ray detector on IMP-6, are reported. These measurements confirm the hard x-ray or gamma-ray nature of the bursts, as inferred from the original observations by Klebesadel et al., and show that their maximum energy release is in this several-hundred-keV region. Each burst consists of several 1- or 2-second pulses each with the characteristic spectrum of a ~150-keV exponential, followed by a softer decay. There is no evidence of line structure in this energy region, or for a marked change in the energy spectrum within a given pulse. Event size spectra are estimated for galactic and extragalactic models; the total emission is consistent with present measurements of the diffuse background, and is unlikely to account for any spectral feature in the few-MeV region. (auth)

16814 FLUCTUATIONS IN THE INTEGRATED X-RAY BACKGROUND. Rowan-Robinson, M.; Fabian, A. (Queen Mary Coll., London). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 419-435(May 1974).

The theory of fluctuations in the integrated background radiation from discrete sources is developed, including the effects of telescope beam profile, extended sources, dispersion in luminosity of sources, and cosmological evolution in the source population. For homogeneously distributed point sources, the fluctuations do not contain any information additional to the background intensity and the source count relation. If the Uhuru x-ray sources at high galactic latitude and the integrated background come from the same population, this could either be the Seyfert galaxies with no evolution or either the Abell clusters or the radio galaxies with moderately strong evolution. The present observational limit on the fluctuations probably rules out the possibility that all the background comes from normal galaxies distributed in superclusters containing ~10^4 galaxies, although about 60 percent could do so. (auth)

16815 EMPIRICAL MODELS OF COSMIC RAY PROPAGATION IN THE GALAXY. Ptuskin, V. S. (AN SSSR, Moscow. Fizicheskij Inst.). Astrophys. Space Sci.; 28: No. 1, 17-30(May 1974).

The homogeneous and flat diffusion models of the propagation of cosmic rays through the Galaxy are considered. It is shown that, with the usual choice of galactic parameters, in particular, those pertaining to its gas distribution, and subject to the restriction of not too heavy nuclei (nuclei no heavier than iron), both models are equivalent from the point of view of the description of the element composition of cosmic rays. This conclusion is justifiable both for galactic and metagalactic theories of the occurrence of cosmic rays. A connection is established between the effective path length of the matter which nuclei encounter in the Galaxy and the parameters of the diffusion model with an inhomogeneous distribution of an interstellar gas. Initial results allow the interpretation of a relationship of cosmic ray element composition to their energies. Restrictions which must be placed on such a relationship are shown from the different data on cosmic rays at the Earth. (auth)

16816 THE CHEMICAL COMPOSITION OF COSMIC RAY NUCLEI ABOVE 1.3 GeV n^{-1} AND 23 GeV n^{-1}. Badhwar, G. D. (Cosmic Ray Group, Johnson Space Center, Houston, Texas, USA); Osborn, R. W. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Astrophys. Space Sci.; 28: No. 1, 101-109(May 1974).

Measurements made with a balloon-borne counter telescope having an exposure factor of 774 m^2sr s are reported. The telescope was flown from Palestine, Tex., during the fall of 1971 for a total of 10h under an average residual atmospheric depth of 4.4 g cm^{-2}. The data analysis indicates that the integral flux ratios above 1.3 GeV n^{-1} and 23 GeV n^{-1} are consistent with energy independence. (auth)

16817 CHARGE RATIO OF ENERGETIC COSMIC-RAY MUONS AS A FUNCTION OF ZENITH ANGLE. Ng, L. K.;

Wolfendale, A. W. (Univ. of Durham, Eng.). Nuovo Cim.; 22A: No. 2, 251-262(21 Jul 1974).

A summary was made of all the available data on the charge ratio of cosmic-rav muons at energies above 50 GeV. The data were combined into zenith-angle bins and average values were plotted for mean angles of approximately 0, 60 and 80°. Following the method outlined by MacKeown and Wolfendale an approximate analysis was made to determine limits on the ratio of kaons to pions (K/π) and K^+/K^- for energetic secondaries produced in the interactions of primary particles in the energy range (500 to 10000) GeV. It is shown that there is no evidence for a dramatic change in these quantities over the next decade of energy above that available at the Intersecting Storage Ring experiment at CERN. (auth)

16818 FLUX OF MEDIUM ENERGY DEUTERONS AT 6 M W. E. UNDERGROUND. Alcock, C. R.; Tyndel, M.; Yock, P. C. M. (Univ. of Auckland, New Zealand). Nuovo Cim.; 22B: No. 1, 43-48(11 Jul 1974).

The flux of near-vertical deuterons at 6 m w.e. underground with momenta in the range (0.84 + 1.15) GeV/c has been measured. The flux is $(7.6 \pm 2.3) \cdot 10^{-10}$ deuterons $cm^{-2}\ s^{-1}\ sr^{-1}\ (MeV/c)^{-1}$. This result is of relevance to searches for new heavy particles in the cosmic rays. The flux of medium-energy tritons is also discussed. (auth)

16819 EXPERIMENTAL DETERMINATION OF MOISTURE RESERVES IN MOUNTAIN SNOW COVER FROM THE ABSORPTION GALACTIC COSMIC RADIATION. Avdiushin, S. I.; Barabanshchikov, Yu. F.; Kogan, R. M.; Kulagin, Yu. M.; Nazarov, I. M., Fridman, Sh. D.; Yudkevich, I. S. (Institut Prikladoni Geofizik, Moscow). Meteorol. Gidrol.; 98-102(Dec 1973). (In Russian).

Stars

Refer also to abstracts 16884–16886, 17344, 17345, 17360, and 17537.

16820 (COO-3071-95) MASS AND STABILITY OF RIGIDLY ROTATING RELATIVISTIC POLYTROPES. Van Riper, K. A. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 6 May 1974. 80p. Dep. NTIS $7.00.

The energy of a rigidly rotating star is written in the first and second post-Newtonian approximation. Conditions for equilibrium and stability are derived, as well as evolutionary paths for stars shedding angular momentum or mass. For polytropic index $n > 1$, these analytic results agree with exact numerical results to within a few percent as long as the general relativity index $(P/\rho c^2)_c < 0.1$. The energy method is applied to low-mass white dwarfs, to semi-relativistic neutron stars, and to supermassive stars. (auth)

16821 (NP-20003) PLASMA TURBULENT BOILING IN COLLAPSARS. Kaplan, S. A.; Tsytovich, V. N. (AN SSSR, Moscow. Fizicheskij Inst.). 1973. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The plasma nature of accretions, which are necessary in extended theoretical developments, is considered. The excitation of very strong plasma turbulence in the vicinity of collapsars during accretions is probably unavoidable. The excitation of strong plasma turbulences sharply decreases the electroductivity of the plasma and significantly increases its viscosity. The excitation of plasma turbulence generally always results in very fast dissipation of energy. In turbulent plasma boiling the electromagnetic radiation is close to the frequency ω_R showing the basic characteristics of the boiling. A formula is derived for the spectral intensity and total output of the radiation of the boiling. (JSR)

16822 UNUSUAL INFRARED SOURCE NEAR THE ROSETTE NEBULA. Cohen, M. (Univ. of California, Berkeley). Astrophys. J.; 185: No. 2, L75-L78(15 Oct 1973).

Ground-based infrared observations are reported of an AFCRL rocket infrared source. The source lies near the rim of the Rosette Nebula, very close to a small red fan-shaped nebula, and may represent a highly obscured protostar. (auth)

16823 DETECTION OF ^{17}O IN IRC + 10216. Rank, D. M. (Univ. of California, Santa Cruz); Geballe, T. R.; Wollman, E. R. Astrophys. J., Lett.; 187: No. 3, L11-L12(1 Feb 1974).

Lines of the fundamental vibration–rotation band of $^{12}C^{17}O$ were observed near 4.7 μ in IRC + 10216. Lines of $^{12}C^{18}O$ were not detected, indicating a lower limit of 5 for the abundance ratio $^{17}O/^{18}O$. A lower limit of 200 and a probable value of 400 was obtained for the ratio $^{16}O/^{17}O$. The presence of $^{12}C^{17}O$ is also indicated in α Her and α Sco. (auth)

16824 HIGH HELIUM ABUNDANCES IN TWO PLANETARY NEBULAE. Kaler, J. B. (Univ. of Illinois, Urbana). Astrophys. J., Lett.; 188: No. 1, L15-L17(15 Feb 1974).

Two planetary nebulae, Me 2-2 and Hu 1-2, were found to have helium to hydrogen ratios of 0.14 and 0.15, respectively, well in excess of the ratios for H II regions. Absolute Hβ fluxes were measured for both nebulae. (auth)

16825 DYNAMICAL STABILITY OF STATIONARY DYNAMO MAGNETIC FIELDS. Levy, E. H. (Univ. of Maryland, College Park). Astrophys. J.; 187: No. 2, 361-367(15 Jan 1974).

The effect of the magnetic field stress on the dynamical stability of stationary dynamo magnetic fields is investigated. It is found that half of the stationary states, which arise in the kinematic approach to hydromagnetic dynamo theory, are dynamically unstable and thus will not appear in nature. The rest are stable. (auth)

16826 THERMAL PULSES IN HELIUM SHELL-BURNING STARS. III. Gingold, R. A.; Faulkner, D. J. (Australian National Univ., Canberra). Astrophys. J.; 188: No. 1, 145-148(15 Feb 1974).

The thermal and pulsational stability of a 0.7 $M_\odot$ pre-white-dwarf helium shell-burning star previously evolved by Wood and Faulkner was examined and the nature of the instability found by them is confirmed. The peak nuclear burning produces pulsational instability in the star but the e-folding time is comparable with the duration of the instability. The effects of thermal imbalance were not included in the pulsational-stability analysis. (auth)

16827 ORBITAL ELEMENTS AND ABSOLUTE DIMENSIONS OF THE ECLIPSING SYSTEM LY AURIGAE. McCluskey, G. E. Jr. (Lehigh Univ., Bethlehem, PA); Kondo, Y. Astrophys. J.; 187: No. 1, 93-97(1 Jan 1974).

Orbital solutions were obtained for the early-type eclipsing binary LY Aurigae from the light curves obtained with the OAO-2 by Heap and from the V light curve obtained from ground-based observations by Mayer and Horak. The solutions took into account the existence of a nearby (0.5" separation) companion not accounted for by previous investigators. The spectroscopic observations by Mayer and Batten were used to compute absolute dimensions for the binary orbit and for each component. This binary system presents a unique opportunity to determine accurately the absolute dimensions of an O9.5 III star. (auth)

16828 MONTE CARLO SIMULATION OF VOIGT DISTRIBUTIONS IN PHOTON DIFFUSION PROBLEMS. Lee, J. S. (Naval Research Lab., Washington, DC). Astrophys. J.; 187: No. 1, 159-161(1 Jan 1974).

A simple and exact formula is presented for randomly selecting the emission or absorption frequency for a scattering photon from a Voigt distribution. Theoretical proof of the validity of this formula is given, and numerical values of the generated frequency distribution are compared with tabulated values of the Voigt function. (auth)

16829 CRITERION FOR THE ONSET OF DYNAMICAL INSTABILITY BY A NONAXISYMMETRIC MODE OF OSCILLATION ALONG A SEQUENCE OF DIFFERENTIALLY ROTATING CONFIGURATIONS. Chandrasekhar, S. (Univ. of Chicago). Astrophys. J.; 187: No. 1, 169-174(1 Jan 1974).

A variational base is derived for locating the point of onset of dynamical instability along a sequence of differentially rotating configurations. The underlying idea is to seek the conditions for the existence of quasi-stationary, nonaxisymmetric modes of deformation in frames of reference rotating with various preassigned angular velocities. (auth)

16830 INTERPRETATION OF EMISSION LINE PROFILES FROM ENVELOPES OF Be STARS. I. The Radiation Field. Kriz, S. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 3, 143-152(1974).

A solution of the equation of line radiation transfer for a moving envelope of a Be star is presented. Formulae are derived for the mean intensity of the radiation J and for the emission line profile. Illustrative computations of the line profiles are presented. The possibility of determining the physical conditions of the envelope directly from the observed emission line profiles is discussed. (auth)

16831 PHOTOELECTRIC PHOTOMETRY OF TV CASSIOPEIAE. Papousek, J. (Univ., Brno). Bull. Astron. Inst. Czech.; 25: No. 3, 152-160(1974).

1583 photoelectric observations in B and V and 1469 in U color were carried out at the Brno Observatory in 1972. Nine new times of primary minimum light, derived on the basis of these observations, are presented. The photoelectric orbital solution is ambiguous, two different solutions exist. The limb darkening coefficient for the primary component was derived from the light curve. (auth)

16832 INFRARED OBSERVATIONS OF TWO SYMMETRIC NEBULAE. Cohen, M.; Barlow, M. J. (Univ. of California, Berkeley). Astrophys. J.; 185: No. 1, L37-L40(1 Oct 1973).

Infrared observations of NGC 7635, IC 1470, and their early-type central stars are presented. Large excess fluxes were found at both 10 and 20 μ, which are interpreted as due to thermal emission by cool dust. (auth)

16833 ABUNDANCE OF BORON, BERYLLIUM, AND LITHIUM IN THE PECULIAR A STAR KAPPA CANCRI. Boesgaard, A. M.; Heacox, W. D. (Univ. of Hawaii, Honolulu). Astrophys. J.; 185: No. 1, L27-L31(1 Oct 1973).

A weak feature in the spectrum of κ Cnc is attributed to B II, and the abundance B/H is found to be $\sim 2 \times 10^{-7}$. The abundance of Be is determined to be Be/H $\sim 2.5 \times 10^{-9}$. Wavelength measurements indicate that there is little, if any, ^{7}Be or ^{10}Be. An upper limit of Li/H $< 4.5 \times 10^{-7}$ has been determined. The galactic-cosmic-ray origin of the light elements is insufficient to account for the Be and B abundances by 2 to 3 orders of magnitude and for the B/Be ratio of 75. It is suggested that a nearby supernova explosion or spallation reactions on the surface of this Mn–Hg Ap star could account for the observed abundance ratios. (auth)

16834 MAXIMUM MASS OF A NEUTRON STAR. Rhoades, C. E. Jr.; Ruffini, R. (Princeton Univ., NJ). Phys. Rev. Lett.; 32: No. 6, 324-327(11 Feb 1974).

On the basis of Einstein's theory of relativity, the principle of causality, and Le Chatelier's principle, it is here established that the maximum mass of the equilibrium configuration of a neutron star cannot be larger than $3.2M_{\odot}$. The extremal principle given here applies as well when the equation of state of matter is unknown in a limited range of densities. The absolute maximum mass of a neutron star provides a decisive method of observationally distinguishing neutron stars from black holes. (auth)

16835 INFRARED SURVEY OF RW AURIGAE STARS. Glass, I. S.; Penston, M. V. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 237-249(May 1974).

An infrared photometric survey of 89 RW Aur type variables in both hemispheres has been made. JHKL magnitudes and colors are listed. The RW Aur variables include a small number of highly reddened late-type stars. All T Tauri and hot Orion population stars show infrared excesses and the infrared properties mark certain field stars as being young. The greatest infrared excesses are found for A and F stars while young variable B stars usually show no excesses. The location of the RW Aur stars in the two-color H-K, K-L diagram favor dust re-radiation over free-free emission as the mechanism responsible for the infrared excess. A weak correlation of H-K with emission class links the occurrence of circumstellar dust and gas shells. (auth)

16836 LONG PERIOD, HIGH LATITUDE, ECLIPSING SYSTEMS V748 CEN (= CEN X-4 QUERY) AND BL TEL. Van Genderen, A. M.; Glass, I. S.; Feast, M. W. Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 283-298(May 1974).

Extensive photoelectric photometry (Walraven system) as well as infrared photometry and spectroscopy of V748 Cen (= S5003 Cen) are discussed. This object is found to be a binary showing total eclipses. The secondary is an M-type star. Gas streams in the system seem necessary to explain various aspects of the photometry as well as a shell absorption spectrum just before eclipse and a low-excitation emission spectrum during totality. Infrared photometry of BL Tel shows the presence of a cool secondary. This (M-type) star is probably larger than the supergiant F primary and the eclipses are partial. Complicating effects probably include an atmospheric eclipse by the secondary. The considerable distance of these systems from the galactic plane and their relation to such binaries as AR Pav and (nova) TCrB are briefly discussed. The possibility that the primary of V748 Cen like that of some related systems is highly evolved and that the heating effect of the gas stream was unusually strong near the epoch of the appearance of the transient (nova-like) x-ray source Cen X-4 makes the identification with this source at least plausible. There also seems to be some similarity of V748 Cen to the optical candidate for another transient x-ray source, 2U 1543-47. (auth)

16837 INFRARED PHOTOMETRY OF SOUTHERN EMISSION-LINE STARS. Allen, D. A.; Glass, I. S. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 337-350(May 1974).

A search for 2.2-μm continua in southern compact planetary nebulae and emission-line stars has proved about 50 percent successful. The objects detected are probably not conventional planetary nebulae and appear to form two groups, one of which is identified with symbiotic stars and the other with early-type forbidden-line stars. (auth)

16838 SPECTROSCOPY OF THE ECLIPSING VARIABLE AR PAVONIS. Thackeray, A. D.; Hutchings, J. B. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 319-336(May 1974).

Spectra of the remarkable symbiotic object AR Pavonis covering 20 years (12 eclipse periods) are analyzed for radial velocities and line-intensities. The eclipsed body shows an emission O-type spectrum with H, He I (triplets, singlets), N III, He II 4686 emission having increasing concentration to the center in that order. A mass function of $0.14_{\odot}$ is found. In the nebular spectrum the [O III] (4959 + 5007)/4363 ratio is found to be 2.8 ± 0.3 indicating log $N_e \sim 7$, i.e. a much higher density than planetaries and more comparable with Z And and AG Peg; the absence of [Ne V], [Fe V] to [Fe VII] emission indicates a lower ionization temperature for AR Pav. The forbidden emission apparently varies with small velocity amplitude significantly out of phase with the primary source. The secondary is believed to be M3 III (possibly variable) whose TiO bands can be detected within 50 days of mid-eclipse; supporting evidence is provided by observations in J-L bands by Glass. The cF shell absorption, very strong during the 1954 egress when the variable was unusually bright, can be detected weakly through the cycle, possibly weaker with primary behind. Radial velocities suggest closer association with the primary than with the secondary. A model is proposed in which the M star is filling its Roche lobe and losing mass to the secondary through a stream which is mainly responsible for the cF absorption. Masses of order 2.5 and $1.2_{\odot}$ for the primary and secondary are regarded as most likely. Although the distance cannot be accurately determined the primary is estimated to have $M_v \sim -2.5$ (mean) while the system reached $M_v \sim -4$ at the 1954 outburst. The changing structure of the Balmer emission is explained as due to a hydrogen shell surrounding the system and expanding with velocity 22 km s^{-1}. The P Cyg structure seems to have changed permanently since Sahade's 1948 observations. (auth)

16839 MODEL ATMOSPHERE ANALYSIS OF THE METAL-RICH GIANT IOTA DRACONIS. Williams, P. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 359-367 (May 1974).

Using model atmospheres and high dispersion (2.2 Å mm^{-1}) spectrograms observed with the Isaac Newton telescope, the K2 III giant ι Draconis was found to have twice the metal content of the solar composition giant ϵ Virginis. Using a least squares procedure, the microturbulence was found to be intermediate (1.4 km s^{-1}) between those of ϵ Vir and the Sun. The temperature and surface gravity were solved for simultaneously using colors, Fe I lines, the absolute magnitude, and the Fe and Ti ionization equilibria, and were found to be $T_e = 4530$ K and $g = 400$ cm s^{-2}. Using these parameters, the abundances of Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Y, and Zr were derived. The hyperfine structure of some V and Co lines was allowed for explicitly. (auth)

16840 LIGHT CURVE AND ORBITAL ELEMENTS OF XZ Sgr. Knipe, G. F. G. (Royal Observatory, Cape Town). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 369-374(May 1974).

The Algol-type eclipsing binary XZ Sgr was observed in Johannesburg during 1971 following a recommendation of Commissions 30 and 42 of the IAU. Approximately 600 observations each were obtained in B and V, and 78 in U, mostly near primary minimum. XZ Sgr consists of an A3 primary and a G5 secondary component, the primary star being somewhat large and over-luminous and the secondary star, which fills its Roche lobe, being greatly over-luminous for its mass. Using Smak's spectroscopic data, the masses and radii of the stars are found to be 1.8 $M_{\odot}$, 1.59 $R_{\odot}$ and 0.26 $M_{\odot}$, 2.44 $R_{\odot}$. (auth)

16841 LINEAR POLARIZATION OF 53 CAMELOPARDALIS. Finn, G. D.; Kemp, J. C. (Hawaii Univ., Honolulu). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 375-391(May 1974).

Equations are derived for the Stokes parameters of light scattered by a layer of elementary electric dipoles lying on the surface of a magnetic star based on the classical Hanle effect. Using appropriate geometric parameters, components of the Stokes vector are integrated analytically over the frequencies of a normal Zeeman triplet and numerically over the visible disk of the star. The results of this calculation are compared with the recent broadband observations and Kemp & Wolstencroft (Mon. Not. R. Astr. Soc.; 166 : 1(1974)) for the linear polarization of 53 Cam. It was found that a combined longitudinal and transverse displacement of the magnetic dipole from the center of the star is necessary for good agreement between the observed and calculated results. The effect of this model on the effective magnetic field of the star is briefly discussed. (auth)

16842 ORIGIN OF THE CHEMICAL ELEMENTS AND STELLAR EVOLUTION. Sears, R. L. (Univ. of Michigan, Ann Arbor). J. Roy. Astron. Soc. Can.; 68: No. 1, 1-12(Feb 1974).

Progress in the understanding of stellar nucleosynthesis is outlined. Bethe provided groundwork which has needed elaboration to explain a stellar site where postulated reaction series can occur naturally. Most of the helium in the Universe appears in fact to have been produced in a nonstellar environment. Thermonuclear reactions between charged particles account for most of the elements up through iron whereas neutron capture by abundant nuclei produces most of the elements from iron to uranium and beyond. (CA)

16843 TURN-OFF POINT OF OMEGA CENTAURI. Cannon, R. D.; Kontizas, M. (Royal Observatory, Edinburgh, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 51P-56P(May 1974).

Photoelectric and photographic photometry to below V = 19 in the globular cluster ω Cen indicate that the main-sequence turn-off point occurs at about V = 18.3, nearly four magnitudes below the horizontal branch. ω Cen thus differs from most other clusters which have been studied, since this magnitude difference is usually near 3.4 mag. Some implications are discussed briefly. (auth)

16844 X-RAY EMISSION FROM CATACLYSMIC VARIABLE STARS. Warner, B. Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 47P-50P(May 1974).

An estimate of the x-ray flux from the hot-spot model of cataclysmic variables is in agreement with the recent detection of soft x rays from SS Cyg. Rates of mass transfer are $\sim 10^{-8} M_{\odot}$ yr^{-1} in dwarf novae and $\sim 10^{-7} M_{\odot}$ yr^{-1} in classical novae. Some implications of these rates are discussed. Possible x-ray candidates for RW Tri and U Gem are proposed. (auth)

16845 CN STRENGTHS IN M67 AND NGC 188. Pagel, B. E. J. (Royal Greenwich Observatory, Hailsham, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 413-417(May 1974).

Using (R-I), (B-V) and Spinrad and Taylor's (Astrophys. J.; 157 : 1279(1969)) T-index as temperature criteria, it turns out that the CN blocking fractions measured by them in M67 and NGC 188 giants are consistent with metal abundances intermediate between those of the Sun and the Hyades except in the case of stars in the "clump" at $(B-V)_0 \simeq 1.05$, $M_v \simeq 1.0$. (auth)

16846 NEAR-INFRARED PHOTOMETRY OF GLOBULAR CLUSTERS. The Metal-Rich Cluster 47 Tucanae (NGC 104). Evans, T. L. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 393-411(May 1974).

Photographic photometry on the VI system is presented for a complete sample of 185 stars brighter than I = 13.0 in an annulus between 3′ and 8′ from the center of 47 Tucanae. Photometry is also given for 47 red giant stars nearer or further from the center and for most of the 23 red variables now known. New spectral types are given for 11 stars near the red-giant tip. There is a well-defined giant branch, clearly divided into main and asymptotic branches between I = 12.5 and 12.1. Above this both branches share a gap about $0^m.25$ wide. There is no asymptotic branch below I = 12.5, while above I = 11.8 the giant branch is wide but not resolved into two branches. A small number of stars lying to the blue of the giant branch may be cluster members. There do not appear to be any carbon stars near the top of the giant branch. Comparison with theoretical calculations indicates that excursions from the asymptotic giant branch as a result of instabilities in the He-burning shell do not extend to very high surface temperature. The observational red-giant tip occurs at lower temperature than the helium flash predicted for appropriate composition. This may result from the theoretical envelopes and the color–temperature relation predicting colors which are too blue, for which there is some independent evidence, as well as from uncertainties in the chemical composition. Star counts in annuli of various radii show that the red giants are more concentrated to the cluster center than the integrated light of the cluster, providing a possible explanation for the reported radial change in integrated color. (auth)

16847 EXISTENCE OF CONVECTIVE CORES IN MASSIVE STARS. Saio, H. (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., First Ser.; 56: No. 2, 57-61(Sep 1973).

Tayler's criterion to check the existence of stellar convective core was extended by taking into account accurately the effects of radiation pressure. Applying this extended criterion, the plausibility about the existence of convective cores in some stellar models computed on massive star evolution was investigated. (auth)

16848 ON SECULAR STABILITY OF TIDALLY DISTORTED STARS OF ARBITRARY STRUCTURE. Kopal, Z. (Manchester Univ. (UK)). Astrophys. Space Sci.; 27: No. 2, 389-418(Apr 1974).

A theory is developed which should make it possible to investigate secular stability of close binary systems, consisting of tidally-distorted components of arbitrary internal structure, by a minimization of the potential energy of the system as a whole. Appropriate expressions for the total potential energy of a close binary are formulated. The nature of the tide-generating potential and its effects on the shape of each star are discussed. The amplitudes of partial tides raised by this potential are specified, for stars of arbitrary structure, correctly to terms of second order in superficial distortion; and the effects of interaction between rotation and tides investigated to the same degree of approximation. The concluding section contains an explicit formulation of different constituents adding up to the total potential energy of the system, which can be used as a basis for its secular stability by the methods outlined already in our previous investigation (Kopal, 1973). (auth)

16849 A NOTE ON ANISOTROPIC CONVECTION AND THE ROTATION OF STELLAR CONVECTIVE ZONES. Roxburgh, I. W. (Queen Mary Coll., London (UK)). Astrophys. Space Sci.; 27: No. 2, 419-424(Apr 1974).

The interaction of rotation and convection produces a latitude dependent anisotropic turbulent viscosity. When this fraction is dominant, equilibrium of a convective outer layer of a star is achieved by an equatorial acceleration and a two-zone circulation, towards the equator at low surface latitudes. (auth)

16850 NON-UNIFORMLY ROTATING, SELF-GRAVITATING, COMPRESSIBLE MASSES WITH INTERNAL MERIDIAN CIRCULATION. Roxburgh, I. W. (Queen Mary Coll., London (UK)). Astrophys. Space Sci.; 27: No. 2, 425-435(Apr 1974).

The structure of self-gravitating, inviscid, compressible fluids is investigated assuming a polytropic relation between pressure and density. A class of solutions with non-uniform rotation and internal meridian circulation are presented and the stream lines of the flow calculated using a perturbation technique. (auth)

16851 A GRAPHICAL METHOD FOR ESTIMATING OVERSHOOT IN CONVECTIVE STELLAR ATMOSPHERES. Cheng, J. C. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Astrophys. Space Sci.; 27: No. 2, 303-305(Apr 1974).

A graphical method for estimating convective overshoot in stellar atmospheres is proposed. Applying the method to the solar atmosphere, it is found that a convective element which starts at a depth of about 1000 km below the top of convection zone can penetrate to a height about 300 km above it. (auth)

16852 ELECTRON CAPTURE IN CARBON DWARF SUPERNOVAE. Mazurek, T. J.; Truran, J. W.; Cameron, A. G. W. (Yeshiva Univ., New York (USA). Belfer Graduate School of Science). Astrophys. Space Sci.; 27: No. 2, 261-291(Apr 1974).

The rates of electron capture on heavier elements under the extreme conditions predicted for dwarf star supernovae have been computed, incorporating modifications that seem to be indicated by present experimental results. An estimate of the maximum possible value of such rates is also given. The distribution of nuclei in nuclear statistical equilibrium has been calculated for the range of expected supernovae conditions, including the effects of the temperature dependence of nuclear partition functions. These nuclide abundance distributions are then used to compute nuclear equilibrium thermodynamic properties. The effects of the electron capture on such equilibrium matter are discussed. The results of supernova numerical hydrodynamics incorporating the computed equilibrium properties and the influence of electron capture are presented. In the context of the "carbon detonation" supernova model, the dwarf central density required to assure core collapse to a neutron star configuration is found to be slightly higher than that obtained by Bruenn (1972) with the electron capture rates of Hansen (1966). (auth)

16853 EMISSION LINES IN THE SPECTRA OF SOUTHERN LONG-PERIOD VARIABLES. Buscombe, W.; Simon, L. W. (Northwestern Univ., Evanston, Ill. (USA)). Astrophys. Space Sci.; 27: No. 1, 157-165(Mar 1974).

The long-period variables are among the largest, coolest and most tenuous stars known. With typical radii greater than 100 times the Sun's, and masses only 1 to 2 solar units, most of them have a range of 2 to 6 visual magnitudes or more, during periods which range from 80 to 1000 days. Their spectra are the most complex of all stellar objects. Virtually all of the atomic and molecular lines, either in emission or absorption, change with time. Much of the behavior seems to be correlated with the light cycle, although the easily observable characteristics such as period, light curves, spectral types and wideband colors do not follow well-defined relations. Quantitative measures are presented for the intensity of emission features in the spectra of 32 southern red variables. (auth)

16854 MAGNETIC BRAKING DURING STAR FORMATION I. Gillis, J. (Weizmann Inst. of Science, Rehovoth (Israel). Dept.

of Applied Mathematics); Mestel, L.; Paris, R. B. (Manchester Univ. (UK)). Astrophys. Space Sci.; 27: No. 1, 167-194(Mar 1974).

The transport of angular momentum from a cool massive gas cloud by Alfvén waves travelling along the distorted magnetic field linking the cloud with the hot galactic background is studied. The efficiency of braking is never so great as to keep the cloud even roughly corotating with the background. The mathematical approximations are not quite sharp enough to give a definitive answer to the question: is the braking ever so efficient that the centrifugal forces are kept well below gravity, so that the cloud contracts at the (magnetically-diluted) free-fall rate?; or is the cloud maintained in approximate centrifugal balance, with the rate of contraction determined by the loss of angular momentum? (auth)

16855 EVOLUTION OF CENTRAL STARS OF PLANETARY NEBULAE TOWARDS THE CRYSTALLIZING WHITE DWARF STAGE. De Angelis, U.; De Cesare, L.; Forlani, A. (Osservatorio Astronomico di Capodimonte, Naples (Italy)); Platania, G. (Naples Univ. (Italy). Istituto di Fisica). Astrophys. Space Sci.; 27: No. 1, 217-225(Mar 1974).

The evolution of the central stars of planetary nebulae, interpreted as hot white dwarfs with liquefying cores, towards the cold white dwarf stage is discussed and theoretical (non-computational) evolutionary tracks are built for such central stars as they cool towards the crystallizing region. The conclusions seem to hint a picture in which crystalline white dwarfs can be looked at as final stages of the central stars of planetary nebulae. (auth)

16856 TABULAR MASS SOLUTIONS FOR CLOSE BINARIES. Giannone, P.; Giannuzzi, M. A. (Rome Univ. (Italy)). Astrophys. Space Sci.; 27: No. 1, 245-251(Mar 1974).

The solutions for the mass of single-line close binaries with Main-Sequence primaries are given in a tabular form as a result of the application of the mass-luminosity relation. Linear interpolation in a compact bi-variate table suffices to give the values of mass of the two components for a wide range of masses and to a very good approximation. The indeterminacy of the solutions depending on the formulation of the mass-luminosity relation for the primaries is discussed, as well as the condition of filling up their Roche lobes by the secondaries. (auth)

16857 THE COOLING OF LIQUEFYING HOT WHITE DWARFS. De Angelis, U.; De Cesare, L.; Forlani, A. (Osservatorio Astronomico di Capodimonte, Naples (Italy)); Platania, G. (Naples Univ. (Italy)). Astrophys. Space Sci.; 27: No. 1, 117-135(Mar 1974).

The consequences of gas-liquid phase transitions in the core of hot white dwarf stars are discussed. Expressions for the latent heat and the liquefaction curve $Tl = Tl(\rho)$ are obtained. Then a model for a hot white dwarf is introduced and the corresponding liquefaction sequences are built on the H–R diagram; relations luminosity-central temperature and effective temperature-central temperature are also given for liquefying white dwarfs. Finally the cooling curves are obtained for such stars taking account the effect of latent heat emission. The results seem to suggest a possible identification of the central stars of planetary nebulae as hot liquefying white dwarfs. (auth)

16858 ON THE INTERPRETATION OF WHITE DWARF SPECTRA. D'Antona, F.; Mazzitelli, I. (Consiglio Nazionale delle Ricerche, Rome (Italy)). Astrophys. Space Sci.; 27: No. 1, 137-146(Mar 1974).

Following the line of research outlined by Strittmatter and Wickramasinghe (1971) and recently by Shipman (1972), attention was drawn to the study of convective zones in white dwarfs for various masses and chemical compositions, in order to understand some observational features of their spectra. According to the results, convection strongly depends on the mass of the star, for $M \lesssim 0.5\ M_{\odot}$, and low hydrogen abundances ($X \simeq 0.2$) are sufficient to decrease the extension of the He-convection zones with respect to pure-He models. It is shown that the existence of DB white dwarfs seems not in agreement with the accretion rates predicted by Bondi (1952), and that DB's must evolve into H-lacking white dwarfs. (auth)

16859 MODEL OF THE EJECTION OF MATERIAL BY NOVAE. Malakpur, I. (Institut d'Astrophysique de Paris, France). Astrophys. Space Sci.; 27: No. 2, 467-484(Apr 1974). (In French).

It is found that the gas of the premaximum, diffuse-enhanced and orion systems is produced by the nova itself and is ejected by shock waves in the form of discrete layers. The principal envelope originates in the gas responsible for the premaximum system, as a result of considerable, sudden increase of the radiation pressure of $L\alpha$, a certain time after the beginning of the nova explosion. The radiation pressure accelerates a part of the premaximum envelope and it is this accelerated part of the premaximum envelope that forms the principal envelope of nova. This acceleration is then transferred to the outer regions of the envelope. The mass of the principal envelope therefore increases continuously. All the previous theories that have been proposed for the formation of the principal envelope have been rejected because the authors of the theories have supposed that the principal envelope is formed at the moment of the luminosity maximum, while in the case of Nova Delphini 1967, it has been found that the principal envelope was formed about 125 days before the luminosity maximum. By accepting that the premaximum, diffuse-enhanced and orion layers are ejected by shock waves and that the principal system is produced by radiation pressure, one can interpret the luminosity curve and the variation of the radial velocity of each system as a function of time and the observed sporadic changes of luminosity or radial velocity. It is found that the luminosity comes from the gas associated with the principal envelope and that its mass is about 80% of the mass of the all matters ejected by a nova, during its activity. The cause of the nova explosion is discussed and it is concluded that there is no satisfactory theory of novae. (auth)

16860 A POSSIBLE THEORETICAL EXPLANATION OF THE ERRATIC PERIOD CHANGES OF THE RR LYRAE VARIABLE IN GLOBULAR CLUSTERS. Laskarides, P. G. (Athens Univ. (Greece)). Astrophys. Space Sci.; 27: No. 2, 485-488(Apr 1974).

Repeated observations of the RR Lyrae stars in some globular clusters have shown that some of these variables have considerably changed their periods. The question arises whether these changes are due to evolution of the stars along horizontal branch (HB) of the H–R diagram. The present understanding of the HB stars in globular clusters is that these stars are post-helium flash stars. A great mass loss (sometimes as much as 20-30%) is postulated to explain the disagreement between their small mass and their short life compared with the slow evolution of main sequence stars of the same mass. It is suggested that this mass loss takes place not only during evolution through the red giant branch and the helium flash phase but also after the helium flash and on the horizontal branch, although in a smaller scale. (auth)

16861 THE PHOTON–NEUTRINO COUPLING THEORY AND STELLAR MODELS. Vilhu, O. (Helsinki Univ. (Finland). Observatory and Astrophysics Lab.). Astrophys. Space Sci.; 27: No. 2, 513-515(Apr 1974).

The effect of the photon-neutrino coupling theory, developed by Bandyopadhyay (1969), on stellar structure is studied by constructing a chemically homogeneous model of one solar mass in thermal equilibrium, and taking into account the neutrinos according to the theory. As anticipated, the effect is large and leads to great difficulties in the understanding of stellar constitution. (auth)

16862 UNIFORM DENSITY EQUILIBRIUM MODEL OF SELF-GRAVITATING STELLAR SYSTEMS. Ahmad, A. (Tata Inst. of Fundamental Research, Bombay (India)). Astrophys. Space Sci.; 27: No. 2, 343-350(Apr 1974).

A class of equilibrium solutions of the Vlasov equation for self-gravitating systems is discussed. The density and the potential are derived in form of Jacobi polynomials, which in a special case give rise to a model with uniform density. (auth)

16863 THE STRUCTURE OF THE DENSE CORES OF H II REGIONS. Dopita, M. A.; Dyson, J. E.; Meaburn, J. (Manchester Univ. (UK)). Astrophys. Space Sci.; 28: No. 1, 61-90(May 1974).

The latest observational and theoretical evidence which suggests the existence of a large number of partially ionized globules (PIG's) in the cores of H II regions is presented. The consequences of this proposition to the structure of the Orion Nebula are then considered. It is suggested that the dense ionized core of M42 is caused by two major ionization fronts eating into a large mass of neutral material which contains many dense neutral globules. The "Hourglass" in M8 is shown to be very similar. (auth)

16864 THE ACCRETION OF MATTER BY A COLLAPSING STAR IN THE PRESENCE OF A MAGNETIC FIELD. Bisnovatyi-Kogan, G. S.; Ruzmaikin, A. A. (AN SSSR Moscow. Matematicheskij Inst.). Astrophys. Space Sci.; 28: No. 1, 45-59(May 1974).

The exact nonstationary solution for the variation of the magnetic field in the Schwarzschild metric with a given spherically symmetric flow is obtained. Initially a homogeneous magnetic field increases with time, changing into a quasi-radial field. On the assumption of equipartition between the magnetic and kinetic energies of a falling gas, in the relativistic case, estimates of the stationary field and the intensity of synchrotron radiation are presented. A considerable part of the radiation is formed in the relativistic region $r \lesssim (2.5 \text{ to } 7.7) r_g$ (r_g is the gravitational radius of a black hole). Estimates are made for radiation from the relativistic region in the case of disc type accretion. (auth)

16865 THE EFFECT OF A TOROIDAL MAGNETIC FIELD ON THE NON-RADIAL OSCILLATIONS OF POLYTROPES. Miketinac, M. J. (Çape Town Univ. (South Africa)). Astrophys. Space Sci.; 28: No. 1, 193-203(May 1974).

Frequencies of non-radial oscillation of polytropic models of stars, belonging to spherical harmonics of orders l = 1, 2 and 3, are evaluated, in a "second approximation", by a variational method. Equilibrium configurations in the presence of toroidal magnetic fields are obtained numerically without any restriction on the field strength. The value of the ratio of the specific heats, γ, is assumed to be equal to 5/3 and only two polytropic indices, n = 1.5 and 3.0, are considered. It is found that a polytropic star stays stable for magnetic fields considerably stronger than expected from the results obtained by the weak field perturbation methods. (auth)

16866 ELECTRONOGRAPHIC MEASUREMENTS OF THE IONIZED HELIUM ABUNDANCE IN THE CORE OF THE ORION NEBULA. Dopita, M. A.; Elliott, K. H.; Meaburn, J. (Manchester Univ. (UK)). Astrophys. Space Sci.; 28: No. 1, 163-171(May 1974).

Measurements have been made with an electronographic image tube spectrograph of two helium and three hydrogen lines at twenty nine positions in the dense core of the Orion Nebula. Values for the helium abundance derived show that a large amount of the helium is neutral. This must be caused by large optical depth variations in the core near partially ionized globules (PIG's). The total abundance of helium is shown to be in the range $0.104 < N(He)/N(H) < 0.132$. (auth)

16867 SOBOLEV'S PHI-FUNCTION OF RADIATIVE TRANSFER IN PLANAR AND SPHERICAL SCATTERING MEDIA. Poon, P. T. Y.; Ueno, S. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). Astrophys. Space Sci.; 28: No. 1, 233-244(May 1974).

In recent years Sobolev's Φ-function of radiative transfer has been discussed in connection with the resolvent of Milne's integral equation such that it plays an important role in the determination of the radiation field in semi-infinite (or finite) atmospheres with internal sources (cf. Sobolev, 1963). In the present paper, the part of Sobolev's Φ-function in plane-parallel and spherical, isotropically scattering, atmospheres with internal source distribution is investigated from analytical and numerical aspects. With the aid of invariant imbedding (cf. Bellman et al., 1968), Sobolev's Φ-function of Milne's integral equation is computed for the planar case by solving the Cauchy system for the auxiliary function and Chandrasekhar's X- and Y- functions. The corresponding Φ-function for the spherical case is readily obtained from the planar case. (auth)

16868 ON THE DURATION OF TOTALITY IN THE ECLIPSE OF ZETA AURIGAE. Kitamura, M. (Tokyo Univ., Mitaka (Japan). Tokyo Astronomical Observatory). Astrophys. Space Sci.; 28: No. 1, L17-L23(May 1974).

From a discussion of narrow-band observations of Zeta Aurigae in the 1963-64 eclipse, the duration of totality has been precisely found to be $\leq$ 36.901 days, which is appreciably smaller than the value 37.48 days currently used. The present result reveals that a hypothesis of gradual expansion of the K-type supergiant component could not be tenable. (auth)

16869 ABUNDANCE RATIOS IN OUTER SHELLS IN PLANETARY NEBULAE: THE KNOT IN NGC 6543. Lee, P.; Kenning, R. (Louisiana State Univ., Baton Rouge). Astrophys. J.; 185: No. 1, L33-L35(1 Oct 1973).

Ionic and total abundance ratios for Ne/H and O/H were derived for a condensation in the outer shell of NGC 6543. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 15543, 16807, 16844, and 16953.

16870 (COO-2271-31) THEORY OF PULSARS: POLAR GAPS, SPARKS, AND COHERENT MICROWAVE RADIATION. Ruderman, M. A.; Sutherland, P. G. (Columbia Univ., New York (USA). Dept. of Physics). 1974. Contract AT(11-1)-2271. 104p. Dep. NTIS $8.25.

The huge magnetic fields characteristic of pulsars cause the nuclei (largely iron) of the stellar surface to form a tightly bound condensed state. Except for the very young Crab pulsar, theory and observation both support the view that the stellar surface is not hot enough to sustain an outflow of positive ions to balance the outward flow of electrons as charge flows out of the magnetosphere through the light cylinder along the open magnetic field lines. Adopting the conventional assumption that electrons do not return to the neutron star by coming back through the light cylinder along the open field lines, one is led to the following consequences for a neutron star whose magnetic moment tends to be antiparallel (as opposed to parallel) to its spin angular momentum: A polar magnetospheric gap is formed that spans the open field lines from the stellar surface up to an altitude of about 10^4 cm. In the gap $\vec{E} \cdot \vec{B} \neq 0$, although it vanishes essentially everywhere else in the near magnetosphere. The potential difference between the base and top of the gap is about 10^{12} volts. The gap continually breaks down (sparking) by forming electron-positron pairs on a time scale of a few microseconds. The gap positrons move out along the open field lines and electrons flow to the stellar surface to close the pulsar's homopolar generator circuit. It is shown that this injection into the near magnetosphere of ultrarelativistic positrons and the pairs subsequently produced by curvature radiation from the positrons leads to coherent microwave radiation in the frequency range and with remarkably many of the characteristics observed in pulsars. The properties and energetics of the sparking in the gap lead directly to (i) the maximum total luminosity of a pulsar and its dependence on period P: $L_{max} \sim 10^{30}\ P^{-15/7} erg\text{-}s^{-1}$, (ii) the observed drifting of subpulses and quantitative expressions for P_2 and P_3, (iii) microstructure of pulses, and (iv) the turn-off of a pulsar as its period increases and associated aging effects appear. The production of coherent microwave radiation in the near magnetosphere results in substantial qualitative agreement with observations in these areas: (i) shapes and widths of pulse envelopes, (ii) their period and frequency dependence, and (iii) the sweep of linear polarization through the pulse envelope. It is shown, finally, why the Crab pulsar gap and the radiation it supports are expected to be different. (auth)

16871 CONFUSION AND FLUX-DENSITY ERROR DISTRIBUTIONS. Condon, J. J. (National Radio Astronomy Observatory, Charlottesville, VA). Astrophys. J.; 188: No. 2, 279-286 (1 Mar 1974).

The amplitude distribution of apparent flux densities due to background or "confusion" sources observed by a pencil-beam telescope in a Universe randomly populated by unresolved sources obeying a power-law number-flux-density relation is derived. It is shown that the detailed form of the distribution depends only on the number-count exponent and that the distribution width scales with beam shape and area in a way which also depends on this exponent, in disagreement with some earlier results. The confusion probability distributions are used to compute error distributions for confusion-limited flux-density measurements. A method for observing moving or variable sources weaker than the confusion limit is analyzed. (auth)

16872 ACCELERATION OF QSO CLOUDS BY RADIATION PRESSURE. Opher, R. (Ames Research Center, Moffett Field, CA). Astrophys. J.; 187: No. 1, 5-9(1 Jan 1974).

One of the more attractive proposals that has been discussed for the explanation of QSO absorption lines having $z_{abs} \ll z_{em}$ is the acceleration of clouds by radiation pressure from resonance-line scattering. Using fairly general assumptions, it is proven that the requisite final velocities $v_f \sim c$ of the clouds cannot be attained by this mechanism. Specifically, it is shown that the final energy per particle due to acceleration from resonant-line scattering is approximately proportional to $\tau g(\tau)$, where $g(\tau)$ is the decrease in radiation intensity due to the optical depth τ. The final energy then does not have an explicit dependence on the oscillator strength of the dominant resonance line or the initial radius of acceleration. Optimizing $\tau g(\tau)$ and using observational data for QSO luminosities and absorption cloud column densities, one finds that the maximum final velocities that can be attained from resonance-line scattering is $\ll c$. As an alternative to resonance-line scattering, the possibility that matter can be accelerated to velocities $v_f \sim c$ by free electron scattering in the outer region of the QSO core is discussed. (auth)

16873 ACCURATE POSITIONS OF OH SOURCES. Wynn-Williams, C. G. (California Inst. of Tech., Pasadena); Werner, M. W.; Wilson, W. J. Astrophys. J.; 187: No. 1, 41-44(1 Jan 1974).

The Owens Valley interferometer has been used at 1665, 1667, and 1720 MHz to measure the positions of 11 OH emission sources. The typical measurement errors were ±4″. The 1720-MHz OH source in W3 (continuum) was found to be 40″ away from the H_2O maser source and was found not to coincide with any radio or infrared feature. Two OH emission sources were found in NGC 7538; one is identifiable with a very compact radio/infrared source, while the other, 80″ to the south, is as yet unidentified. The OH sources 0739-14 and Sharpless 269 also coincide with infrared sources. (auth)

16874 CIRCULAR POLARIZATION OBSERVATIONS OF HZ HERCULES. Stokes, R. A.; Avery, R. W.; Michalsky, J. J. Jr.; Swedlund, J. B. (Battelle Pacific Northwest Labs., Richland, WA). Astrophys. J.; 185: No. 1, L17-L19(1 Oct 1973).

A search for broad-band optical circular polarization in the light from the x-ray binary HZ Her/Her X-1 was carried out during the period 1973 April 5 to 1973 June 3. Observations were spaced in an attempt to check for correlations with the 1.7-day binary eclipse period and the 35-day x-ray on-off cycle. No statistically significant signal was observed at the 0.1 percent level. (auth)

16875 FLUCTUATING MAGNETIC FIELDS IN HD 153919. Kemp, J. C.; Wolstencroft, R. D. (Univ. of Hawaii, Honolulu). Astrophys. J.; 185: No. 1, L21-L25(1 Oct 1973).

Circular polarization in $H\beta$ has been observed in HD 153919. It varies over time scales as short as 10 minutes, but shows generally smaller average values over periods of 1 to 3 hours. The fluctuations are largest on the peak and trailing portions of the x-ray amplitude. Assignment of the magnetic-field strengths is in doubt because of complexities in the spectrum; present evidence is that only the underlying absorption in the Balmer lines, and presumably in the He II lines, shows Zeeman effects, the emission components being formed in regions of vanishing effective fields. (auth)

16876 INFRARED STUDIES OF H II REGIONS AND OH SOURCES. Wynn-Williams, C. G. (California Inst. of Tech., Pasadena); Becklin, E.E.; Neugebauer, G. Astrophys. J.; 187: No. 3, 473-485(1 Feb 1974).

The observational results of a high spatial-resolution mapping and photometric study in the wavelength range $1.65 \leq \lambda \leq 20\mu$ of four H II regions and seven OH sources are reported. Infrared emission indicative of the presence of heated dust was found from the compact H II condensations in W51, DR 21, and NGC 7538. Infrared emission was also found from the positions of maser sources in NGC 7538, W75 (N), W75 (S) and Sharpless 269, but not from that in W51. An extended infrared source was found coincident with the peculiar OH source OH 0739-14. (auth)

16877 INFRARED EMISSION FROM THE SOUTHERN H II REGION H2-3. Becklin, E. E. (California Inst. of Tech., Pasadena); Frogel, J. A.; Kleinmann, D. E.; Neugebauer, G.; Person, S. E.; Wynn-Williams, C. G. Astrophys. J.; 187: No. 3, 487-489 (1 Feb 1974).

The H II region H2-3 has been found to have a large infrared flux with a luminosity of 1 to 2×10^5 $L_\odot$ between 1.65 and 25 μ. Most of this flux comes from a single component with a diameter of 110″ (2 pc). At 2.2 μ there is an unresolved source which is identified as the exciting star of the nebula; it can provide the required ionization and the total luminosity observed at infrared wavelengths. The 3- to 25-μ radiation is shown to be consistent with the dust heated by Lα radiation within the nebula, but much of the 40- to 350-μ radiation probably originates from outside the H II region. (auth)

16878 UPPER MASS LIMIT FOR QUASAR. Paczynski, B. (Polska Akademia Nauk, Warsaw). Nature (London); 249: No. 5455, 329-330(24 May 1974).

The radio source 4C 11.50 = 1548 + 115 is reported to be composed of a pair of quasars 5 arc sec. apart. The first quasar, 4C 11.50a, has a redshift 0.4359 and is of approximately 17 mag., while the second, 4C 11.50b, has a redshift 1.901, with magnitude 19. It is stated that if the redshifts are cosmological the mass of the first quasar must be less than $\sim 4 \times 10^{12} M_\odot$. (UK)

16879 STRUCTURE OF 3C 139.2, 3C 154, 3C 172, AND 3C 215 AT 327 MHz. Kapahi, V. K.; Gopal-Krishna; Joshi, M. N. (Tata Inst. of Fundamental Research, Bombay). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 299-309(May 1974).

Accurate radio positions and high-resolution brightness distributions derived from lunar occultations observed at 327 MHz are presented for 3C 139.2,154, 172, and 215. All the sources are resolved and show considerably more detail in their brightness distributions than is known from the lower-resolution interferometric observations at higher frequencies. Possible identifications with faint objects are suggested for 3C 154 and 3C 172. The QSS 3C 215 is a symmetric double with no structure finer than 1 second of arc, and has the lowest known ratio of component separation to component size among the 3C quasars. (auth)

16880 COUNTER-ROTATION OF POLARIZATION VECTORS IN PULSARS. Smith, F. G. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 43P-46P(May 1974).

The plane of polarization rotates within individual sub-pulses of PSR 0809 + 74 in the opposite sense to the rotation in the integrated profile. This observation favors the identification of the subpulses with a basic beaming process, while the integrated profile represents a distribution of sources in longitude. (auth)

16881 RADIO OBSERVATIONS OF QSOs IN THE DIRECTIONS OF ABELL CLUSTERS OF GALAXIES. Stannard, D.; Browne, I. W. A. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 37P-39P(May 1974).

Radio observations are reported of nine optically selected quasars in the directions of Abell clusters of galaxies. Only one is found to be a radio source stronger than 40 mfu at 962 MHz, and this has a redshift much greater than that of the associated cluster. (auth)

16882 MORPHOLOGY OF EXTRAGALACTIC RADIO SOURCES OF HIGH AND LOW LUMINOSITY. Fanaroff, B. L.; Riley, J. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 31P-35P(May 1974).

The relative positions of the high- and low-brightness regions in the extragalactic sources in the 3CR complete sample are found to be correlated with the luminosity of these sources. (auth)

16883 HIGH RADIO POLARIZATION OF 4C 47.08. Porcas, R. W.; Treverton, A. M.; Wilkinson, A. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 41P-42P(May 1974).

Measurements are presented of the radio position and linear polarization of the unusual radio source 4C 47.08. A neutral stellar object identified with the source has been shown to have a featureless optical spectrum. (auth)

16884 COSMIC GAMMA-RAY EMISSION AND COMET COLLISIONS WITH COMPACT STARS. Guseinov, O. Kh. (Shemakha Astrophysical Observatory, Shemakha, U. S. S. R.); Vanysek, V. (Karlova Universita, Prague (Czechoslovakia)). Astrophys. Space Sci.; 28: No. 1, L11-L15(May 1974).

The probability that γ-ray bursts may be generated by the infall of comet-like objects on the neutron stars, as recently proposed by Harwit and Salpeter (1973), is reexamined. Although hypothetical cometary clouds around the parent star may survive the supernova outburst virtually untouched, the frequency of γ-outbursts due to the comet impact on the neutron star or white dwarf is only about 10^{-3} of the observed occurrence. A considerably higher rate of comets passing per year at critical periastron distance must be assumed if the γ-ray outbursts are due to collision of comets with compact stars. (auth)

16885 ON THE EXPANSION OF SUPERNOVA SHELLS. Maceroni, C.; Salvati, M.; Pacini, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astrophys. Space Sci.; 28: No. 1, 205-212(May 1974).

A simple model for the effects of a central pulsar on the expansion of supernova shells is investigated. Some numerical results relevant to the Crab Nebula are also reported. (auth)

16886 ON THE MASS DETERMINATION OF COLLAPSED OBJECTS IN CLOSE BINARIES: APPLICATIONS TO BLACK-HOLES AND NEUTRON STARS. Kondo, Y. (National Aeronautics and Space Administration, Houston, Tex. (USA). Manned Spacecraft Center). Astrophys. Space Sci.; 27: No. 2, 293-301 (Apr 1974).

Observational information required for determination of the masses of collapsed objects in close binaries is examined. Assumptions commonly used to evaluate the masses or their lower limits, in the absence of the required observational data, are critically discussed. A reliable determination of the mass of a collapsed object in X-ray emitting binaries is yet to be made. No definitive case has been made for or against the existence of a black-hole in CygX-1. (auth)

16887 ON THE FORMATION AND UNFOLDING OF PULSE HEIGHT DISTRIBUTIONS. Hoyng, P.; Stevens, G. A. (Rijksuniversiteit Utrecht (Netherlands)). Astrophys. Space Sci.; 27: No. 2, 307-321(Apr 1974).

Spacecraft measurements of X-ray or particle pulse height distributions have become increasingly accurate during the last fifteen years, and they will continue to do so. The question of how one can reconstruct original photon or particle spectra from measured pulse height distributions is considered. The statistical aspects of the formation of pulse height distributions are investigated. A method is presented that allows for a reliable reconstruction of the original spectrum. Its essentials are the formulation and subsequent solution of a matrix equation connecting pulse height distribution with photon/particle spectrum; an error analysis of the reconstructed spectrum is given. The present method has two advantages over the usual χ^2-minimum method: It is able to recover more spectral detail and it requires less computing time. Finally, a numerical example is given. (auth)

16888 ON THE EQUILIBRIUM FIGURES OF AN IDEAL ROTATING LIQUID IN THE POST-NEWTONIAN APPROXIMATION OF GENERAL RELATIVITY I. Equilibrium Conditions. Pyra-

gas, K. A.; Bondarenko, N. P.; Kravtsov, O. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Astrophys. Space Sci.; 27: No. 2, 437-452(Apr 1974).

Distributions of velocities and condition of equilibrium for a perfect rotating fluid are obtained by Lyapunov's method in the general relativistic post-Newtonian approximation. The Born-type rigid rotation is discussed. (auth)

16889 ON THE EQUILIBRIUM FIGURES OF AN IDEAL ROTATING LIQUID IN THE POST NEWTONIAN APPROXIMATION OF GENERAL RELATIVITY II. Maclaurin's P-ellipsoid. Bondarenko, N. P.; Pyragas, K. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). Astrophys. Space Sci.; 27: No. 2, 453-466(Apr 1974).

Maclaurin's P-ellipsoid, which is an equilibrium figure in the post-Newtonian approximation of general relativity, is constructed in the neighborhood of Maclaurin's classical ellipsoid. Its shape and rotation velocity are investigated. It is shown that in the case of a P-ellipsoid with the mass and the angular momentum of a basic ellipsoid the effects of general relativity reduce the rotation velocity and decrease its volume. (auth)

16890 γ-RAY OBSERVATIONS FROM THE OSO-3 SATELLITE. Badhwar, G. D. (National Aeronautics and Space Administration, Houston, Tex. (USA). Manned Spacecraft Center); Kaplon, M. F. (City Coll., New York (USA)); Valentine, D. A. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Astrophys. Space Sci.; 27: No. 1, 147-155(Mar 1974).

The results on γ-rays obtained from the analysis of 5800 orbits of data from the University of Rochester telescope on board the OSO-3 satellite are presented. For γ-rays of energy greater than 100 MeV, an upper limit of 2.3×10^{-4} cm^{-2} s^{-1} std has been placed on the diffuse (assumed isotropic) flux. An upper limit to the flux from the Sun is set at 3.2×10^{-5} and 2.4×10^{-5} cm^{-2} s^{-1} for energies greater than 40 MeV and 100 MeV, respectively. All flux values are calculated assuming a π^0-decay source of γ-rays. (auth)

16891 REDSHIFT-MAGNITUDE RELATIONS FOR QUASARS. Krieger, C. J. (San Francisco, Calif., U.S.A.). Astrophys. Space Sci.; 27: No. 1, 241-243(Mar 1974).

Because of the cosmological implications, redshift-magnitude relations for quasars have been investigated recently by Bahcall and Hills (1973), Burbidge and O'Dell (1973), Sandage (1972), Setti and Woltjer (1973), Tifft (1973), and others. Krieger and Solheim (1971) and (1973) studied this relation for 102 quasars known in 1969. The discovery of additional quasars suggests a reexamination of the problem. Two cosmological models represent the observed magnitudes and redshifts of 150 quasars well with $\langle M_v \rangle = -22.75$ and -22.67, respectively. The luminosity function is derived. (auth)

16892 A NEW ROCKET MEASUREMENT OF THE DIFFUSE X-RAY BACKGROUND. Horstman-Moretti, E.; Fuligni, F.; Horstman, H. M.; Brini, D. (Consiglio Nazionale delle Ricerche, Bologna (Italy)). Astrophys. Space Sci.; 27: No. 1, 195-201(Mar 1974).

A rocket measurement of the X-ray cosmic diffuse background is presented. The data, that can be fitted to a power law 47 $E^{-2.1 \pm 0.25}$ photons (cm^{2}s sr keV)$^{-1}$, were obtained with detectors of different apertures. The result is compared to a previous rocket measurement where a screened detector had been used to evaluate the instrumental background. Results are in substantial agreement. (auth)

16893 NUCLEAR GOBLINS AND COSMIC GAMMA RAY BURSTS. Zwicky, F. (California Inst. of Tech., Pasadena (USA)). Astrophys. Space Sci.; 28: No. 1, 111-114(May 1974).

Among the cosmic and the macroscopic bodies composed of nuclear matter, the neutron stars and the nuclear goblins represent typical configurations. Nuclear goblins are stable only under large external pressure, in the interior of certain types of stars for instance. When propelled to the surface of their parent stars, and there exploding, they produce flares. When ejected from their parent stars and exploding in interstellar space they will give rise to short bursts of gamma rays, with energies centered around 0.78 MeV and with characteristics which are in accord with the observations on the gamma ray pulses detected in recent years by the four Vela spacecraft. (auth)

16894 NEUTRINO REACTIONS IN STRONG MAGNETIC FIELD. Canuto, V.; Chou, C. K. (National Aeronautics and Space Administration, New York (USA). Goddard Inst. for Space Studies); Chiuderi, C. (Observatorio Astronomico, Arcetri, Firenze, Italy); Fassio-Canuto, L. (Dept. of Physics, New York Institute of Technology, New York, N. Y., U. S. A.). Astrophys. Space Sci.; 28: No. 1, 145-161(May 1974).

The energy losses due to several neutrinos processes: (1) synchrotron neutrinos, (2) pair annihilation neutrinos, (3) plasmon neutrinos, and (4) photoneutrinos in the presence of a superstrong magnetic field are presented. Numerical results are tabulated and illustrated for several values of densities and temperatures. In the low density regime ($\rho \lesssim 10^7$ g cm^{-3}) the presence of a magnetic field decreases the luminosity, whereas the opposite is true at higher densities. This last effect is however almost entirely due to the existence of a new process, the synchrotron neutrinos that disappear when $H \to 0$. Even though the overall effect can only be quantitatively ascertained after a complete cooling computation is performed, one should however expect a much lower temperature for neutron star surface than the one computed in the $H = 0$ case. (auth)

16895 OBSERVATION OF SOFT X-RAY EMISSION FROM A REGION NEAR PER X-1. Agrawal, P. C.; Long, K.; Garmire, G. P. (California Inst. of Tech., Pasadena (USA)). Astrophys. Space Sci.; 28: No. 1, 185-191(May 1974).

Soft X-ray emission from the X-ray source Per X-1 was observed in the 0.4-2 keV energy interval from a rocket borne X-ray detector. Spectral analysis of the data indicates that in the 0.4-2 keV band the X-ray emission from Per X-1 can be fitted either with a power law of slope $-(4.8 \pm 1.2)$ or a thermal bremsstrahlung spectrum with a kT value of $(0.26^{+0.12}_{-0.06})$ keV. Such a steep spectrum is consistent with the spectrum measured above 2 keV. The measured flux in 0.4-2 keV band corresponds to X-ray luminosity of 3×10^{45} ergs s^{-1} for Per X-1. (auth)

16896 MECHANICAL PROPERTIES OF THE NEUTRON LATTICE IN PSR 0833-45. Jones, P. B. (Oxford Univ. (UK). Dept. of Nuclear Physics). Astrophys. Space Sci.; 28: No. 1, 213-223 (May 1974).

The mechanical properties of a possible solid core in the pulsar PSR 0833-45 are examined in relation to the observed changes in period and their interpreparation by Pines, Shaham and Ruderman (1972). Qualitative arguments based on known characteristics of solid He^3 and assuming a many-body Hamiltonian with non-directional two-particle potentials indicate that the neutron lattice should have a high value of Poisson's ratio and allow dislocation glide at low applied stresses. A possible explanation of the sudden failure of the core and the upper limit for the creep rate may be found in the quantum mechanical tunnelling model of dislocation intersection introduced by Mott (1956). The present oblatness parameter is estimated to be $\epsilon \lesssim 4 \times 10^{-4}$. It is predicted that the magnitude and frequency of period changes should decrease significantly in the remaining part of the century. (auth)

Solar Phenomena

Refer also to abstracts 15547, 15556, 16713, 16851, and 16890.

16897 (CONF-730804-P4, pp 2695-2696) S-056 TESTS AND SOFT X-RAY SCATTERING. Froechtenigt, J. F. (Martin Marietta Aerospace, Denver). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

The S-056 experiment is a grazing incidence telescope which is operated on the Skylab mission as part of the ATM cluster of viewing instruments. It will gather data in the 6 to 60 Å spectral region regarding x-ray emissions by the solar atmosphere. The Space Physics Laboratory at Martin Marietta Aerospace in Denver evaluated the performance of three fused silica and one Kanigen coated beryllium mirror as candidates for the flight. Soft x-ray scattering measuring was also made on candidate materials for future x-ray telescopes. (auth)

16898 (LA-UR-74-919) TITIUS-BODE LAW AND THE POSSIBILITY OF RECENT LARGE SCALE EVOLUTION IN THE SOLAR SYSTEM. Nieto, M. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 10p. (CONF-740643-1). Dep. NTIS $4.00.

From symposium on Velikovsky and the recent history of the solar system; Hamilton, Ontario, Canada (16 Jun 1974).

It is pointed out that it is by no means clear that the Titius–Bode Law of Planetary Distances is indeed a "Law," even though there are enticing indications. Given this, it is argued that if one assumes that the Law is a "Law" and that the planets obey it, then this argues against recent large scale evolution in the solar system. Put another way: one can believe in the Titius–Bode Law or in recent large scale evolution or in neither of them. But it appears difficult to believe in both of them. (auth)

16899 (SAND-74-26) SOLAR INCIDENCE FACTOR AND OTHER GEOMETRIC CONSIDERATIONS OF SOLAR ENERGY COLLECTION. Schimmel, W. P. Jr. (Sandia Labs., Albuquerque,

N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 22p. Dep. NTIS $4.25.

A vector analysis was made of the 5-degree-of-freedom system occurring in a flat plate or focused collector system. The results of this analysis were extended to include the case of an intermediate flat plate reflector. Because the expressions obtained are very general in nature, it is possible to work from local weather bureau data (with an appropriate scale factor to take into account the ratio of specular to total insolation) for a comparison of various proposed collector systems. Armed with these results, systems analysts can begin to optimize candidate systems and evaluate the effect of system constraints. They will be freed from the tedious geometrical task of specifying incident radiation, so they can devote more time to the physics of solar absorption and other system considerations. (auth)

16900 AUTOIONIZATION SPECTRA OF BERYLLIUM (Be I AND Be II) IN THE 110- TO 140-eV ENERGY RANGE. Mehlman, G.; Esteva, J. M. (CNRS, Bellevue, France). Astrophys. J.; 188: No. 1, 191-195(15 Feb 1974).

A total of 35 new resonances have been identified in the absorption spectrum of beryllium, 20 of them belonging to the neutral atom, the others to the singly ionized one. The upper levels involve excitation of one of the K-shell electrons and appear in most cases dominated by the core structure. Therefore agreement between experimental and theoretical values is only fair and might be improved with multiconfiguration methods of computation. (auth)

16901 HYPERFINE DOUBLING SPECTRUM OF SULFUR HYDRIDE IN THE $^2\Pi_{\frac{1}{2}}$ STATE. Meerts, W. L.; Dymanus, A. (Univ. of Nijmegen, Netherlands). Astrophys. J., Lett.; 187: No. 1, L45-L46(1 Jan 1974).

The hyperfine Λ-doubling spectrum of the five lowest rotational states of the $^2\Pi_{\frac{1}{2}}$, $v = 0$ state was measured using the molecular-beam electric-resonance method. From the Stark splittings of the observed transitions the value of the electric dipole moment of SH was determined: $\mu = 0.7580(1)$ D. (auth)

16902 SOLAR ELECTROMAGNETIC RADIATION. Tobias, C. A. (Univ. of California, Berkeley); Todd, P. pp 101-114 of Space Radiation Biology and Related Topics. Tobias, C. A. (ed.). New York; Academic Press, Inc. (1974).

General features of solar radiation are summarized under the following topics: solar electromagnetic radiation; black-body radiation; solar corona; solar flares; solar radio emissions; radio waves from the quiet Sun; radio emissions during flares; solar weather forecasting; solar x rays; x rays from the quiet Sun; x-ray emissions and solar disturbances; and solar ultraviolet radiation. 33 references.

16903 CARBON, NITROGEN, AND SULFUR IN LUNAR FINES 15012 AND 15013: ABUNDANCES, DISTRIBUTIONS AND ISOTOPIC COMPOSITIONS. Chang, S.; Lawless, J.; Romiez, M.; Kaplan, I. R.; Retrowwski, C.; Sakai, H.; Smith, J. W. (Ames Research Center, IA). Geochim. Cosmochim. Acta; 38: No. 6, 853-872(Jun 1974).

Lunar fines 15012,16 and 15013,3 were analyzed by stepwise pyrolysis and acid hydrolysis as well as complete combustion in oxygen to determine carbon, nitrogen, and sulfur. In addition, hydrogen was analyzed during pyrolysis as well as during hydrolysis. In the former case, it was released by mineral grains to which it was adsorbed or from cavities within which it had been captured. Hydrogen released during hydrolysis had largely resulted from dissolution of metallic iron. By comparison of the distribution frequencies of C, N, S, H_2, and Fe with ^{4}He, considered to have arisen from solar-wind contribution, it is concluded that nitrogen and hydrogen have largely a solar origin. Carbon has a significant solar contribution, and metallic iron may have resulted from solar-wind interaction with ferrous minerals on the lunar surface. Sulfur probably has a predominantly lunar origin. There is no direct evidence for meteoritic contribution to these samples. Solar-wind interaction also has a marked effect on the stable isotope distribution of $^{13}C/^{12}C$, $^{15}N/^{14}N$, and $^{34}S/^{32}S$. In all cases, the heavy isotope was most enriched in the smallest grain-size fraction. During stepwise pyrolysis, CH_4, CO_2, CO, and N_2 were obtained at different temperatures and displayed different isotopic ratios. The carbon fraction most enriched in ^{13}C, was CH_4 liberated at 600 to 800°C with $\delta^{13}C \approx +45.7‰$. Between 400 and 600°C, N_2 was liberated with $\delta^{15}N \approx +119‰$ and at 600 to 800°C, N_2 was liberated with $\delta^{15}N \approx +75‰$ relative to terrestrial atmospheric nitrogen. (auth)

16904 SOLAR RADIO FLUX MEASUREMENTS ON WAVELENGTHS OF 37 CM, 56 CM, AND 115 CM. Tlamicha, A.; Kepka, O. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 3, 160-162(1974).

The reconstruction of the solar radio receivers at the Ondrejov Observatory is described. The determination of the value of the total flux from the spectral curve and the daily values of the solar flux in the period of February 1973–November 1973 are presented. (auth)

16905 QUASI-PERIODIC PULSATIONS AT DECIMETRIC WAVELENGTHS DURING THE SOLAR RADIO EVENTS OF AUGUST 4, 1972. Tlamicha, A. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 3, 168-170(1974).

Observations of the quasi-periodic pulsations during the large solar activity of August 4, 1972 made with the solar radio spectrograph at the Ondrejov Observatory are presented. The photometrical method was used to analyze the periodicity of the pulsations of the bursts. The histogram showed a principal period of 0.3 sec. (auth)

16906 SOLAR RADIO SPECTROGRAPH FOR THE FREQUENCY RANGE 70 TO 810 MHz. Tlamicha, A. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 3, 163-167(1974).

The equipment for obtaining solar radio spectra of bursts on metric- and deci-metric wavelengths is described. The sweep rate of the spectrograph is 16 sweeps per second and can be varied up to 100 sweeps per second. All data are recorded on 35 mm film at one of the three possible speeds, 18, 26, and 56 millimeters per minute. The flux calibration is made by noise generator. To avoid interferences of strong transmitters, negative modulation is used. (auth)

16907 LARGE SUNSPOT GROUPS IN THE YEARS 1955—1964. Kopecky, M.; Kotrc, P. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 3, 171-180(1974).

On the basis of Greenwich observational data, a catalog of large sunspot groups with an average area of more than 500 millionth, observed in the years 1955–1964, was compiled and compared with a similar catalog of Gnevysheva, compiled from Pulkovo sunspot catalogs. The time pattern of the occurrence of large sunspot groups in the 19th cycle of solar activity is discussed. It is pointed out that the occurrence of large sunspot groups is evidence that an outburst of solar activity in certain time intervals takes place simultaneously over most of the solar surface, probably regardless of hemispheres. (auth)

16908 X-RAY OBSERVATIONS OF CHARACTERISTIC STRUCTURES AND TIME VARIATIONS FROM THE SOLAR CORONA: PRELIMINARY RESULTS FROM SKYLAB. Valana, G. S.; Davis, J. M.; Giacconi, R.; Krieger, A. S.; Silk, J. K.; Timothy, A. F.; Zombeck, M. (American Science and Engineering, Cambridge, MA). Astrophys. J.; 185: No. 1, L47-L51(1 Oct 1973).

Examples taken from the S-054 x-ray telescope observations made during the first Skylab mission show the hot coronal plasma tracing the configuration of the magnetic fields. The high spectral resolution and sensitivity of the instrument has enabled the following two facts to be more firmly established: (a) that the "quiet homogeneous corona" is in fact highly structured and that the structures observed appear to be the results of dispersed active region magnetic fields; and (b) that numerous bright points are distributed randomly on the disk. Their presence at high latitudes may play a role in solar cycle models. In addition, the capability of Skylab for studying time evolution has enabled the restructuring of coronal features to be seen at times of high activity, indicating a restructuring of the coronal magnetic fields. (auth)

16909 SPECTRAL FLUXES OF SOLAR RADIATION PENETRATING INTO THE SEA. Pivovarov, A. A.; Anisimova, E. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 6, 649-654 (1973). (In Russian).

The results of the experimental determination of the magnitude of the total and spectral flux of solar radiation penetrating to different sea depths are reported. The magnitudes of the relative spectral fluxes at different depths and the values of the volume attenuation factor of the total flux and the corresponding portions of the solar radiation spectrum were determined. Data are reported on changes with depth of the spectral composition of the solar radiation penetrating under the sea surface. (tr-auth)

16910 SOLAR ACTIVITY AND CLIMATIC CHANGE. Prus-Chacinski, T. M.; Francis, J. R. D. (C. H. Dobbie and Partners, London). Nature (London); 249: No. 5453, 197(10 May 1974).

Reference is made to Gribbin (Nature 246 : 453(1973)). In this connection attention is drawn to an unpublished thesis by J. Laszewski (Univ. of Warsaw) that supports Gribbin's suggestions (a translation of this thesis is available in the library of the Institution of Civil Engineers, London). Laszewski has collected long-term records of the mean annual discharges of many rivers all over the world and finds that the discharges vary in a cyclic manner connected in a complex way with sunspot cycle. The data indicate that the 200 yr. cycle suggested by Gribbin may be detectable. (UK)

16911 LIGHTNING INCIDENCE IN BRITAIN AND THE SOLAR CYCLE. Stringfellow, M. F. (Electricity Council Research Centre, Capenhurst, Eng.). Nature (London); 249: No. 5455, 332-333(24 May 1974).

It is stated that there is an underlying cyclic variation in the incidence of lightning, with a period of about 11 yr, in phase with the solar cycle, and with an amplitude of ±30% of the mean. A correlation of 0.8 was obtained. (UK)

16912 COMMENTS ON PAPER "THE SOLAR WIND CYCLE, THE SUNSPOT CYCLE AND THE CORONA" BY J. HIRSHBERG. Diodato, L.; Moreno, G. (Consiglio Nazionale delle Ricerche, Rome (Italy). Lab. Plasma nello Spazio). Astrophys. Space Sci.; 28: No. 1, L7-L10(May 1974).

Hirshberg (1973) has discussed the long-term variations of the solar wind bulk speed and interplanetary magnetic field, in connection with the sunspot cycle and the coronal activity. Bulk velocity measurements in the period 1962-1970, previously collected by Gosling (1971), were interpreted by Hirshberg in terms of a "solar wind cycle" out of phase with respect to the sunspot cycle. The present note checks the real existence of the bulk velocity modulation proposed by Hirshberg, taking advantage of the intercalibrations among a number of plasma experiments recently performed by Moreno and Signorini (1973). (auth)

16913 THE ADIABATIC COOLING OF THE PROTONS IN THE SOLAR WIND: THE CASE WHERE THE INTERPLANETARY MAGNETIC-FIELD IS OF SPIRAL FORM. Eyni, M.; Kaufman, A. S. (Hebrew Univ., Jerusalem (Israel)). Astrophys. Space Sci.; 28: No. 1, 177-183(May 1974).

This is a sequel to the paper by Eyni and Kaufman (1971) in which the coordinate systems with respect to the magnetic direction and solar radial-direction were assumed coincident. In the present account, it is shown that the theoretical expression for the proton cooling derived in that paper is still applicable in the case of the spiral magnetic-field provided the appropriate transformation of kinetic temperature from the magnetic direction to the radial direction as derived here is used. A detailed comparison is made between the present model and other models based on the spiral form of the magnetic field; the agreement is satisfactory. (auth)

16914 HEAT TRANSPORT IN THE SOLAR WIND. Mishin, E. V. (AN SSSR, Moscow. Inst. Zemnogo Magnetizma, Ionosfery i Rasprostraneniya Radiovoln). Astrophys. Space Sci.; 27: No. 2, 367-382(Apr 1974).

Heat transport is considered both for quiet and disturbed solar winds. It is shown that heat may be transferred during solar flares by sharp fronted thermal wave pulses. Energy dissipation in the wave front arises from the firehose instability excitation. The effects of ionosonic turbulence on heat transport in a quiet solar wind are also investigated. A quasi-steady state in which there is a balance between wave-particle interactions and particle collisions is found. It is shown that the effect of wave-particle "collisions" is to produce a significant decrease of the electron heat flow and electron temperature, and increase of the ion temperature relative to calculations which take into account particle-particle collisions only. (auth)

16915 SOLUTION OF ONE-FLUID MODEL EQUATIONS WITH SHORT RANGE RETARDING MAGNETIC FORCES FOR THE QUIET SOLAR WIND. Cuperman, S.; Harten, A. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Astrophys. Space Sci.; 27: No. 2, 383-387(Apr 1974).

The discrepancy of the low predicted versus the observed coronal particle densities is investigated by considering radial magnetic forces acting at the base of the corona in the one fluid model equations with anomalous thermal conductivity for the quiet solar wind. If the short range retarding magnetic force is taken to fall as r^{-5}, r being the heliocentric distance, then in order to obtain satisfactory agreement between the predicted and observed (about 3×10^8 cm^{-3} at 1 $R_\odot$) coronal densities, the strength of the retarding magnetic force at 1 $R_\odot$ should be 1.2 times that of the gravitational force. (auth)

16916 CORRELATION OF INTERPLANETARY SCINTILLATION AND SPACECRAFT PLASMA DENSITY MEASUREMENTS. Houminer, Z.; Hewish, A. (Cambridge Univ., Eng.). Planet. Space Sci.; 22: No. 6, 1041-1042(Jun 1974).

Interplanetary scintillation and spacecraft measurements of proton density are observed to be strongly correlated. This result confirms the association between corotating sectors of enhanced scintillation and compression regions located at the interface between fast and slow solar-wind streams; it also suggests that scintillation observations provide a means of predicting, several days in advance, the arrival at the Earth, of solar plasma of enhanced density. (auth)

16917 SUNSPOT CYCLE AND THE YEARLY VARIATION OF SOLAR MAGNETIC VARIATION AT ISTANBUL. Isikara, A. M. (Univ., Istanbul). Pure Appl. Geophys.; 104: No. 3, 544-552 (1973).

The sunspot cycle variation of the amplitude of the solar magnetic variation was investigated for magnetically moderate, quiet and disturbed days at Istanbul for the period 1949-1968, and fairly good linear relationship was found for Z and D components of the Earth's magnetic field. In some cases, it is rather difficult to say that there is any linear relationship between sunspot number and the amplitude of the H component of the Earth's magnetic field. Meanwhile, K indices were also considered with sunspot number by means of multiple regression analysis to overcome some uncertainties in this investigation. (auth)

Galaxies

Refer also to abstracts 16815, 16863, and 16881.

16918 SPACE DENSITY OF THE MARKARIAN GALAXIES INCLUDING A REGION OF THE SOUTH GALACTIC HEMISPHERE. Huchra, J.; Sargent, W. L. W. (California Inst. of Tech., Pasadena). Astrophys. J.; 186: No. 2, 433-443(1 Dec 1973).

The results are presented of low-dispersion spectroscopic observations of 26 objects in Markarian's fourth list of galaxies with an ultraviolet continuum. This list contains 70 galaxies in an area of the south galactic pole covering some 800 square degrees. Most of the 26 galaxies had already been observed by other workers; however, the discovery of two new Seyfert galaxies are reported, Markarian 315 (II Zw 187) and Markarian 358, which were not recognized earlier. A sample of 242 galaxies in Markarian's lists I-IV was used to derive estimates for the space densities of these objects as a function of absolute magnitude which are improvements over Sargent's earlier estimates. Fainter than $M_p = -21$ the Markarian galaxies comprise about 10 percent of all galaxies. Evidence is presented that the low-luminosity Markarian galaxies, those with $M_p > -18$, are preferentially concentrated in nearby groups and clouds of galaxies. Thus their space density may have been overestimated by using areas of the sky which contain a number of these clouds. (auth)

16919 DIFFERENTIAL COLORS OF NGC 7625. Lynds, B. T.; Furenlid, I. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. J.; 186: No. 2, 445-457(1 Dec 1973).

Image-tube photographs of NGC 7625 in blue light and in the red (on and off of Hα) were used to determine the color variations and Hα emission across the galaxy. Several discrete Hα regions are identified. Evidence is given for the existence of interstellar reddening in the dust lanes consistent with a normal reddening law. The central 4" of the nucleus appears to have a continuum which is redder than the surrounding region. (auth)

16920 STARS BRIGHTER THAN $M_B = -8$ IN THE LARGE MAGELLANIC CLOUD. Osmer, P. S. (Cerro Tololo Inter-American Observatory, Arecibo, Puerto Rico). Astrophys. J.; 186: No. 2, 459-466(1 Dec 1973).

Observations of the 45 brightest stars in Sandulesk's LMC catalog show that in general they are similar to the brightest stars in the SMC, although the LMC contains four early-type stars with extremely strong Hβ emission and four F8 to G4 stars which have no counterparts in the SMC. Comparison with the Radcliffe spectral types shows that c_1 becomes insensitive to temperature in the most luminous early-type supergiants, and consequently B-type supergiants with W-R companions are photometrically indistinguishable from Of stars. The reddening for the brightest stars in the LMC and the SMC is nearly identical. The upper limit in stellar luminosity is well defined and the same in both clouds: $M_{bol} = -11$, which implies a maximum stellar mass of 90 $M_\odot$. The rate of formation of massive stars per unit galactic mass is of the same order of magnitude in both clouds at present. The most luminous stars are B1-B3 supergiants, implying that the blue supergiant phase is relatively long-lived in massive supergiants. (auth)

16921 NUMERICAL STUDY OF THE STABILITY OF FLATTENED GALAXIES: OR, CAN COLD GALAXIES SURVIVE. Ostriker, J. P. (Princeton Univ. Observatory, NJ); Peebles, P. J. E. Astrophys. J.; 186: No. 2, 467-480(1 Dec 1973).

To study the stability of flattened galaxies, the evolution of simulated galaxies containing 150 to 500 mass points was followed. Models which begin with characteristics similar to the disk of the Galaxy (except for increased velocity dispersion and thickness to assure local stability) were found to be rapidly and grossly unstable to barlike modes. These modes cause an increase in random kinetic energy, with approximate stability being reached

when the ratio of kinetic energy of rotation to total gravitational energy, designated t, is reduced to the value of 0.14 ± 0.02. Parameter studies indicate that the result probably is not due to inadequacies of the numerical N-body simulation method. A survey of the literature shows that a critical value for limiting stability $t \simeq 0.14$ has been found by a variety of methods. Models with added spherical (halo) component are more stable. It appears that halo-to-disk mass ratios of 1 to $2\frac{1}{2}$, and an initial value of $t \simeq 0.14 \pm 0.03$, are required for stability. If the Galaxy (and other spirals) do not have a substantial unobserved mass in a hot disk component, then apparently the halo (spherical) mass interior to the disk must be comparable to the disk mass. Thus normalized, the halo masses of the Galaxy and of other spiral galaxies exterior to the observed disks may be extremely large. (auth)

16922 DYNAMICS OF ROTATING STELLAR SYSTEMS: COLLAPSE AND VIOLENT RELAXATION. Gott, J. R. III (Princeton Univ. Observatory, NJ). Astrophys. J.; 186: No. 2, 481-500(1 Dec 1973).

A method for following the dynamics of axisymmetric stellar systems is developed and applied to the problem of collapse and violent relaxation in rotating stellar systems. Utilization of an axisymmetric gravitational potential allows treatment of many more stars than would be feasible with a simple N-body calculation. Systems having differing amounts of initial angular momentum and containing 2000 stars (mass points) each are allowed to collapse under their own gravitational attraction. Collapse and violent relaxation are found to lead to the formation of equilibrium structures after only a few free fall times. The systems contain a sufficient number of mass points so as to be effectively collisionless, and the equilibrium structures are consistent with accurate satisfaction of the stationary collisionless Boltzmann equation. Rotating equilibrium models produced in this way resemble elliptical galaxies, with elliptical isophotes. With cosmologically reasonable amounts of initial angular momentum, E0 to E4.5 galaxies can be produced. The equilibrium models show rotation curves in general agreement with that expected from violent relaxation theory. All models show a central region with solid-body rotation. Farther out, the systems have differential rotation. (auth)

16923 INTERSTELLAR EXTINCTION IN THE ULTRAVIOLET FROM EMISSION STARS. Haramundanis, K. L. (Smithsonian Astrophysical Observatory, Cambridge, MA). Astrophys. J.; 185: No. 2, L87-L88(15 Oct 1973).

An investigation of normal and emission O stars observed by the Celescope experiment on board OAO-2 indicates that interstellar extinction in the ultraviolet cannot be mapped unambiguously by use of O stars unless all the stars in the sample are known not to be emission-line objects. (auth)

16924 AMMONIA IN DARK INTERSTELLAR CLOUDS. Cheung, A. C.; Chui, M. F.; Matsakis, D.; Townes, C. H.; Yngvesson, K. S. (Univ. of California, Berkeley). Astrophys. J.; 186: No. 2, L73-L76(1 Dec 1973).

NH_3 has been found in four cool, dark clouds, giving further evidence for its general distribution in interstellar matter. Inversion radiation was detected from the (1,1) but not from the (2,2) rotational state, indicating kinetic temperatures less than 25°K and molecular densities $\gtrsim 3 \times 10^3$ cm^{-3}. There is some evidence that the NH_3 occurs in condensations substantially smaller in dimension than the entire cloud. (auth)

16925 INTERSTELLAR OXYGEN-17. Encrenaz, P. J. (Goddard Inst. for Space Studies, New York); Wannier, P. G.; Jefferts, K. B.; Penzias, A. A.; Wilson, R. W. Astrophys. J.; 186: No. 2, L77-L80(1 Dec 1973).

Emission from the $J = 1 \rightarrow 0$ transition of $^{12}C^{17}O$ was detected in the two molecular clouds associated with the Orion Nebula and the ρ Ophiuchi complex. $^{17}O/^{18}O$ ratios near the terrestrial value were found in both sources. (auth)

16926 FURTHER EVIDENCE FOR AN INTERSTELLAR SOURCE OF NIGHTTIME He I 584 A RADIATION. Paresce, F.; Bowyer, S.; Kumar, S. (Univ. of California, Berkeley). Astrophys. J., Lett.; 188: No. 2, L71-L73(1 Mar 1974).

The intensity of He I, 584 Å radiation in the night sky was measured from a sounding rocket at altitudes between 160 and 217 km. The results obtained confirm previous measurements of this radiation. The observed intensity and spatial variations can be entirely accounted for by resonance scattering of solar 584 Å radiation from interstellar helium. The best fit to the observations in this case is obtained with an interstellar helium model in which the bulk velocity of the gas is 5 km s^{-1}, the temperature is 10^4 °K, and the helium number density is 0.032 cm^{-3}. Even if a geocoronal scattering component is present, the data can be used to set a lower limit to the temperature of the local interstellar medium of $1.5 \pm 0.5 \times 10^3$ °K, assuming a normal interstellar helium abundance. (auth)

16927 INTERFEROMETRIC SCANS OF INTERSTELLAR K I LINES. Hobbs, L. M. (Univ. of Chicago). Astrophys. J., Lett.; 188: No. 2, L67-L69(1 Mar 1974).

Interferometric scans of the interstellar λ7699 line of neutral potassium are reported toward 26 stars. The advantages of the K I line, as compared with other optical interstellar lines, are discussed. A comparison of the interstellar λ7699 and Lα lines toward 10 stars show that the K/H ratio in the interstellar gas is normal. (auth)

16928 RADIATIVE TRANSFER, EXCITATION, AND COOLING OF MOLECULAR EMISSION LINES (CO AND CS). Scoville, N. Z.; Solomon, P. M. (Univ. of Minnesota, Minneapolis). Astrophys. J., Lett.; 187: No. 2, L67-L71(15 Jan 1974).

The radiative transfer of molecular lines in interstellar clouds having flow velocities large compared with random motions is considered. The equilibrium level populations of CO and CS are calculated including the effects of both self-radiation (radiative trapping) and collisions with hydrogen molecules (using recently measured cross sections). Analytic expressions are also developed for the excitation of a two-level molecule. Because of the velocity gradients in the cloud, the observed emission will originate not only from the near boundary but also from interior regions where excitation is greatly enhanced by scattered photons. This ability to see into the clouds qualitatively accounts for the general similarities of the different line profiles in individual clouds and considerably reduces the density of collisional particles needed to account for the observed excitation. Remarkably, even if $A > C$ but $\tau > 1$, the excitation temperature (and the observed intensity) depends on the molecular density but is totally independent of the spontaneous rate A. The rate of gas cooling by CO molecules in clouds of moderate density ($n_{H_2} \sim 10^3$ cm^{-3}) is high ($\sim 10^{-22}$ ergs cm^{-3} s^{-1}) even when the important cooling transitions ($J = 3 \rightarrow 2$ and higher) are optically thick. These results are applicable to either cloud collapse or expansion. (auth)

16929 IONIZATION OF CARBON AND NITROGEN IN THE INTERCLOUD MEDIUM. Kafatos, M.; Gerola, H.; Hatchett, S.; McCray, R. (National Bureau of Standards, Boulder, CO). Astrophys. J., Lett.; 187: No. 3, L113-L116(1 Feb 1974).

If the intercloud medium in the solar neighborhood was suddenly ionized less than 10^6 years ago, the subsequent relaxation of the gas can account for the very low observed column density of C III and N III yet still leave a significant fraction (~0.05) of ionized hydrogen and of C I in a cold ($T \simeq 20$°K) intercloud medium. The OAO-C Copernicus observations in the direction of λ Sco are consistent with cosmic abundances and a uniform-density medium, except for C III whose predicted column density from the C III ionization zone surrounding the star is a factor ~10 greater than the observed result. (auth)

16930 OBSERVATIONS OF STRUCTURE IN THE INTERSTELLAR POLARIZATION CURVE: PRELIMINARY RESULTS. Mavko, G. E. (Rensselaer Polytechnic Inst., Troy, NY); Hayes, D. S.; Greensberg, J. M.; Hiltner, W. A. Astrophys. J., Lett.; 187: No. 3, L117-L119(1 Feb 1974).

The wavelength dependence of the interstellar polarization curve was measured with higher wavelength resolution than has generally been used before. The data show structure which has been previously unknown, and which may have important implications with respect to the composition of the interstellar grains. It is similar in general form to structure predicted on the basis of a theoretical model designed to give a detailed match to the extinction structure. (auth)

16931 MICROWAVE SPECTRUM OF ^{13}C METHANOL. Haque, S. S. (Univ. of New Brunswick, NJ); Lees, R. M.; Saint Clair, J. M.; Beers, Y.; Johnson, D. R. Astrophys. J.; 187: No. 1, L15-L17(1 Jan 1974).

Laboratory measurements of the frequencies of some astronomically interesting transitions of the ^{13}C isotopic species of methanol are reported. Most lines of the $J = 2 \leftarrow 1$, $3 \leftarrow 2$, $4 \leftarrow 3$ μ_a-type $\Delta k = 0$ transitions in the 94-, 142-, and 189-GHz regions were measured, as well as a number of μ_b-type transitions in the 14 to 50 GHz region. The standard deviation of fit with the constants given is 0.098 MHz. The remaining unmeasured lines in these R-branch patterns have been predicted with an uncertainty of 0.3 MHz. (auth)

16932 IS X-OGEN HCO^+. Herbst, E.; Klemperer, W. (Harvard Univ., Cambridge, MA). Astrophys. J.; 188: No. 2, 255-256 (1 Mar 1974).

A detailed calculation of the rotational spectrum of the ion $H^{13}CO^+$ is performed. The first rotational transition is estimated to occur at 86,720 ± 10 MHz. It is suggested that the $H^{13}CO^+/H^{12}CO^+$ line-intensity ratio may be close to the $^{13}C/^{12}C$ cosmic-abundance ratio. (auth)

16933 CHEMISTRY OF SULFUR IN INTERSTELLAR CLOUDS. Oppenheimer, M.; Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. J.; 187: No. 2, 231-235(15 Jan 1974).

A chemical scheme is proposed for the creation and destruction of interstellar molecules that contain sulfur. The predicted abundances of H_2S, OCS, CS, H_2CS, and SO are consistent with those observed. It is suggested that SN, SN^+, and SO^+ may be present in detectable amounts in dense clouds. (auth)

16934 INTERSTELLAR ABUNDANCE OF TITANIUM. Wallerstein, G. (Univ. of Washington, Seattle); Goldsmith, D. Astrophys. J.; 187: No. 2, 237-242(15 Jan 1974).

From spectrograms of 15 stars combined with data for eight further stars reported by others, the column densities of Ti II were determined for 11 stars and upper limits for 12 stars. Observations and theory can be used to show that little or no Ti I or Ti III is expected to be present in interstellar gas. The derived Ti/H ratios range from 5×10^{-9} to 5×10^{-10}, which is a deficiency of titanium by a factor from 20 to 200. Data and arguments are presented to show that much of the interstellar titanium and calcium is probably locked up in the grains. (auth)

16935 ULTRAVIOLET PHOTOMETRY FROM THE ORBITING ASTRONOMICAL OBSERVATORY. XIV. An Extension of the Survey of Lyman-α Absorption from Interstellar Hydrogen. Jenkins, E. B. (Princeton Univ. Observatory, NJ); Savage, B. D. Astrophys. J.; 187: No. 2, 243-255(15 Jan 1974).

Data from 26 new stars scanned by the Wisconsin far-ultraviolet spectrometer aboard OAO-2 have been combined with an earlier survey of interstellar Lα absorption reported by Savage and Jenkins, thereby giving the H I density to a total of 95 stars. Small revisions have also been made in the column densities toward 15 of the stars in the original survey, owing to an improvement in the corrections for line blending from nearby stellar features. The new observations help fill in some of the vacant areas in the previous sky coverage and also confirm earlier conclusions concerning the regional distribution of local interstellar H I. (WDM)

16936 NOTE ON IONIZATION EQUILIBRIUM. Lafferty, D. L. (Berkeley Analytical Sciences Service, CA). Astrophys. J.; 187: No. 1, 209-210(1 Jan 1974).

The steady-state equations relating the population densities of ionization levels can be obtained from a more general condition than that of detailed balance. That the average value of the charge of the ionized fractions remains fixed is sufficient to ensure the proper recurrence relation. (auth)

16937 STARLIKE NUCLEUS OF NGC 6207. Weedman, D. W. (Vanderbilt Univ., Nashville); Carswell, R. F. Astrophys. J.; 188: No. 1, 1-2(15 Feb 1974).

Photometric and spectroscopic observations confirm that the apparent stellar nucleus of the spiral galaxy NGC 6207 is in fact a foreground star. (auth)

16938 ASSOCIATION OF C^+ AND COH^+ WITH H_2. Fehsenfield, F. C.; Dunkin, D. B.; Ferguson, E. E. (NOAA Environmental Research Labs., Boulder, CO). Astrophys. J.; 188: No. 1, 43-44(15 Feb 1974).

Three-body association-rate constants of C^+ and COH^+ with H_2 were measured at 90°K. The results give some information relative to the same associations by radiative processes. These radiative processes have been proposed as possible precursor steps in the formation of CH and formaldehyde in interstellar clouds. There exist at least two forms of COH_2^+. One, resulting from three-body association of COH^+ and H_2, is rapidly destroyed by CO. The more stable form, presumably protonated formaldehyde, which is stable against reaction with CO proton transfers efficiently with ammonia. Possible implications for interstellar molecule production are discussed. (auth)

16939 NATURE OF THE IONIZING AGENTS OF THE INTERSTELLAR MEDIUM. Meszaros, P. (Princeton Univ., NJ). Astrophys. J.; 185: No. 1, L41-L45(1 Oct 1973).

The ionization structure of the interstellar trace elements predicted by the steady-state cosmic-ray, x-ray, and ultraviolet star ionization models, even when allowance is made for the stellar H II region, is in disagreement with satellite observations of at least two stars. The conclusion is reached that, in some regions of the Galaxy, the flux of cosmic rays or x rays is much smaller than was thought previously. (auth)

16940 DEPLETION OF INTERSTELLAR SODIUM AND CALCIUM. White, R. E. (Goddard Inst. for Space Studies, New York). Astrophys. J.; 187: No. 3, 449-452(1 Feb 1974).

New measurements of the Ca II/Ca I ratios in interstellar clouds lead to the conclusion that not only Ca, but also Na, is underabundant in these regions. Recent calculations of element depletion by accretion of atoms onto dust grains probably cannot account for the observed abundance range. The extreme underabundance of Ca, and some part of the abundance range, probably reflects the composition of the grain cores. (auth)

16941 INTERSTELLAR ABUNDANCES: GAS AND DUST. Field, G. B. (Harvard Coll., Cambridge, MA). Astrophys. J.; 187: No. 3, 453-459(1 Feb 1974).

Data on abundances of interstellar atoms, ions, and molecules in front of ζ Oph are assembled and analyzed. The gas-phase abundances of at least 11 heavy elements are significantly lower, relative to hydrogen, than in the solar system. The abundance deficiencies of certain elements correlate with the temperatures derived theoretically for particle condensation in stellar atmospheres or nebulae, suggesting that these elements have condensed into dust grains near stars. There is evidence that other elements have accreted onto such grains after their arrival in interstellar space. The extinction spectrum of ζ Oph can be explained qualitatively and, to a degree, quantitatively by dust grains composed of silicates, graphite, silicon carbide, and iron, with mantles composed of complex molecules of H, C, N, and O. This composition is consistent with the observed gas-phase deficiencies. (auth)

16942 OPACITY OF THE INTERSTELLAR MEDIUM TO ULTRASOFT X RAYS AND EXTREME-ULTRAVIOLET RADIATION. Cruddace, R.; Paresce, F.; Bowyer, S.; Lampton, M. (Univ. of California, Berkeley). Astrophys. J.; 187: No. 3, 497-504(1 Feb 1974).

The opacity of the interstellar medium at soft x-ray and extreme-ultraviolet wavelengths was reexamined in the light of recent evidence that the density of interstellar hydrogen in the solar neighborhood may be quite low. It is shown that the distance at which significant attenuation occurs is not negligible, especially in the 50 to 300 Å region. (auth)

16943 INTERSTELLAR POLARIZATION FROM A MEDIUM WITH CHANGING GRAIN ALIGNMENT. Martin, P. G. (David Dunlap Observatory, Richmond Hill, Ont.). Astrophys. J.; 187: No. 3, 461-472(1 Feb 1974).

If the direction of grain alignment in the interstellar medium changes along the line of sight to a star, circular polarization can be produced. Models are developed for the polarization from such a medium, as the basis for interpreting existing observations. Emphasis is placed on the numerous relationships between circular polarization, linear polarization, and extinction from which information about the interstellar grains can be derived. Detailed applications are made to both stars and clusters of stars. Some new measurements of circular polarization are reported and observational prospects for the future are evaluated. (auth)

16944 RADIO SURVEY OF INTERACTING GALAXIES. Wright, A. E. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 251-272(May 1974).

A radio survey of 44 interacting systems of galaxies drawn from the Atlas and Catalogue of Interacting Galaxies by Vorontsov-Velyaminov has been made at 2700 and 5000 MHz using the Parkes 64-m telescope. The results have been compared with a larger sample of noninteracting, bright galaxies observed in a similar way at 2700 MHz. It is concluded that the interacting systems investigated show no anomalous radio properties. This conclusion is interpreted as evidence against a nuclear ejection origin for the observed deformations in interacting systems. (auth)

16945 FLUX DENSITIES OF BRIGHT GALAXIES AT 2700 AND 5000 MHz. Wright, A. E. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 273-282.

Radio flux-density measurements made at Parkes are presented for 240 bright galaxies lying south of declination +20°; 193 were observed at 2700 MHz and 47 at 5000 MHz. The measurements furnish a comparison sample for a recent survey of interacting galaxies. (auth)

16946 EFFECT OF POPULATION II STARS AND THREE-DIMENSIONAL MOTION ON SPIRAL STRUCTURE. Hockney, R. W.; Brownrigg, D. R. K. Mon. Notic. Roy. Astron. Soc.; 167: No. 2, 351-357(May 1974).

A three-dimensional computer model of a fully self-consistent isolated disk galaxy of finite thickness is described using approximately 50,000 simulated Population I stars. Population II stars are represented by a fixed imposed gravitational field. This model is used to study the stability of a thin-disk galaxy for varying fractions of Population II stars. Relatively long-lived two- and multi-arm spirals are observed when the proportion of Population II stars is large. Comparison is made of the behavior of the three-dimensional model, in which motion of the Population I stars out of the plane is allowed, and the behavior of the simpler two-dimen-

sional model, in which the motion of the stars is confined to the plane of the disk. The lifetime of the spirals is significantly longer in the more realistic three-dimensional model. A long-lived density-wave spiral is observed lasting, without significant change of shape, for at least 10 rotations, in the presence of strong differential rotation. (auth)

16947 MOLECULAR HYDROGEN IN X-RAY ASTRONOMY. Margon, B. (University Coll., London). Nature (London); 249: No. 5452, 24-25(3 May 1974).

It is stated that there is a serious discrepancy in determinations of the column density of interstellar matter in the direction of the Crab Nebula. Soft x-ray observations give results substantially in excess of determinations based on 21 cm absorption. It seems likely also that this applies to many or all galactic x-ray sources, and if the cause is interstellar it will affect all distance estimates of x-ray sources based on correlated 21 cm and soft x-ray observations. So far there has been no satisfactory explanation, although a number of possibilities have been considered, and are here discussed. It is suggested that interstellar H_2 is responsible for a significant part of the opacity, and this possibility is examined. The chief problem is whether clouds of moderate optical depth can provide sufficient shielding from interstellar uv radiation so that significant H_2 abundance may be expected under equilibrium conditions. The observation of OH and HCHO is compelling evidence for the presence of a substantial amount of H_2, and it is known that all reactions that produce HCHO require H_2. The question is discussed as to whether the inferred amount of H_2 can provide the required opacity. Problems using correlated 21 cm and soft x-ray data to set distances to galactic x-ray sources, and a number of contributions to error, are maintained. It seems that such correlations may not be satisfactory as accurate distance indicators. The suggestions presented may have possible implications in observations of the soft component of the diffuse x-ray background. (UK)

16948 THE CORRUGATION OF THE GALACTIC LAYER. Quiroga, R. J. (Instituto Argentino de Radioastronomia, Parque Pereyra, Buenos Aires, Argentina). Astrophys. Space Sci.; 27: No. 2, 323-342(Apr 1974).

The 21-cm line intensities in a (Z,R) distribution is studied at the locus of tangential points of the inner parts of the Galaxy using both Northern and Southern data. A corrugation effect is observed in the galactic neutral hydrogen layer with an average wave length of 2 kpc and a wave amplitude of 70 pc. The patterns obtained for the I and the IV quadrant indicate that the inner and the outer parts of the spiral arms are located, respectively, below and above the galactic plane. Also, with high angular resolution, the corrugation pattern suggests the existence of "faults" in a geological sense in the interarm zones. Optical studies of spatial distribution of early objects show good agreement with the neutral hydrogen results, indicating that the observed corrugation pattern is an indication of real distribution of matter in the galactic layer, and not of a kinematical effect. (auth)

16949 X-RAY AND RADIO EMISSION BY CLUSTERS OF GALAXIES. Guthrie, B. N. G. (Royal Observatory, Edinburgh (UK)). Astrophys. Space Sci.; 27: No. 2, 489-496(Apr 1974).

Analysis of new X-ray and optical data confirms that the X-ray luminosity L_x of a cluster of galaxies is strongly dependent on its richness. The radio power P_{1445} of clusters at 1445 MHz is independent of richness, but is greater on the average for clusters with dominant cD galaxies than for those without. The radio emission depends on the activity of one of the brightest galaxies; dominant cD galaxies are often responsible for radio emission, especially if they have double or multiple nuclei. For a given richness, high values of L_x and P_{1445} sometimes occur together, but no strict correlation between L_x and P_{1445} exists. Possible tests of thermal-bremsstrahlung and inverse-Compton theories for the X-ray emission are mentioned. (auth)

16950 A COMPARISON CATALOGUE OF H II-REGIONS. Marsalkova, P. (Karlova Universita, Prague (Czechoslovakia)). Astrophys. Space Sci.; 27: No. 1, 3-110(Mar 1974).

For complete information about the apparent distribution of H II-regions along the whole galactic equator a Catalogue of 698 known emission nebulae is given on the basis of 13 lists and catalogues of these objects. The main catalogue used for the northern sky was that of Sharpless (1959) including 313 objects while the coverage of the southern sky can be characterized by a greater number of smaller catalogues represented in the first place by that of Rodgers et al. (1960) and that of Gum (1955). For H II-regions, only optical data were taken into account. Where several authors describe the complex of nebulosities a more detailed specification of objects is preferred. The objects in the Catalogue are listed according to their right ascensions for 1950. As only three catalogues applied here give also the objects out of the belt ±15° around the galactic equator, the Catalogue is divided into two parts. The first (main) part contains 667 objects lying within this belt, the second contains 31 objects lying outside it. A Summary Table listing the objects from the two parts according to their galactic longitudes involving, in addition, the 50-yrs precession for every object is also added. An attempt was made not to repeat contingent errors present in the source-catalogues. The maps of the POSS were often used. Coincidences with SNR and planetaries were sought for independently of identifications given in the source-catalogues. The list of objects from the source-catalogues of H II-regions excluded as SNR, planetaries and galaxies is also given. (auth)

16951 GALAXY MAGNITUDES. I. The Dependence of Photoelectric Measures on Aperture. Kron, G. E. (Flagstaff, Ariz., USA); Shane, C. D. (Lick Observatory, Santa Cruz, Calif., USA). Astrophys. Space Sci.; 27: No. 1, 233-240(Mar 1974).

The dependence of magnitude on the aperture used in photoelectric measures is discussed. Mean results from an empirical study are presented. (auth)

16952 THE PRODUCT AR_0 AND OTHER GALACTIC PARAMETERS. Lohmann, W. (Astronomisches Rechen-Institut Heidelberg, Germany). Astrophys. Space Sci.; 27: No. 1, 227-231(Mar 1974). (In German).

According to the tangential method the product AR_0 is determined with 145.7 km s^{-1} from measurements of the line profiles of the 21-cm line of the neutral hydrogen by Weaver and Williams (1973). The recent individual measurements of Oort's constant A and of the distance R_0 of the Sun from the galactic centre yields 138.5 km s^{-1}. The mean value 142.1 km s^{-1} leads to A = 14.56 km s^{-1} kpc^{-1} and R_0 = 9.76 kpc. At the galactocentric distance R near R_0 the angular velocity is represented by $\omega(R) = 25.84 - 2.98\,(R - 9.76) + 0.075\,(R - 9.76)^2$. The mass of the Galaxy amounts to 1.92×10^{11} M. (auth)

16953 CLUSTERS OF GALAXIES WITH A WIDE RANGE OF X-RAY LUMINOSITIES. Kellogg, E.; Murray, S.; Giacconi, R.; Tannabaum, H.; Gursky, H. (American Science Engineering Inc., Cambridge, MA). Astrophys. J.; 185: No. 1, L13-16(1 Oct 1973).

X rays are observed from 16 Abell clusters in distance classes $D \leq 3$. Ten of these are newly discovered and not listed in the previous Uhuru catalog. A wide range of luminosities is found for all richness classes. Six cases with both x-ray luminosity and velocity dispersion known are consistent with $L_X \propto (\Delta V)^{3.9 \pm 0.8}$. Seven cases where the 22-MHz flux has been measured show a wide spread of relative x-ray and radio luminosity. The discovery of low-richness clusters with high x-ray luminosity provides a possible explanation for some of the unidentified high-latitude x-ray sources. (auth)

Cosmology

Refer also to abstracts 16888, 16889, 17543, and 17551.

16954 (LA-5364) UNIFIED MODEL OF SOLAR SYSTEM AND GALAXY FORMATION BASED ON EXPLOSIVE FRAGMENTATION. Brown, W. K. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

A new cosmogonical model based on postulated fragmentation during postexplosion expansion is proposed. Application to both solar system and galaxy formation produces descriptions of systems closely resembling those presently observed. (auth)

16955 COSMIC ABUNDANCE OF DEUTERIUM. Black, J. H.; Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. J.; 184: No. 3, L101-L104(15 Sep 1973).

The cosmic abundance of deuterium may be derived from the measured ratio of the abundances of the molecules HD and H_2. The derivation is sensitive to the magnitude of the ionizing flux and to the depletion of oxygen and carbon. The abundance of OH is also sensitive to these parameters and should be useful in revealing the amount of deuterium which can exist in atomic form. Observational upper limits on the concentration of OH in regions where HD and H_2 have been observed place a lower bound on the deuterium abundance ratio [D]/[H], while the assumption that ionization of hydrogen is caused only by the observed high-energy cosmic rays provides an upper bound. Observations of the ζ Oph cloud indicate that $2 \times 10^{-6} < [D]/[H] < 2 \times 10^{-4}$. (auth)

16956 VELOCITY OF LIGHT IN A MOVING MEDIUM ACCORDING TO THE ABSOLUTE SPACE–TIME THEORY. Marinov, S. Int. J. Theor. Phys.; 9: No. 2, 139-144(Feb 1974).

Proceeding from absolute space–time conceptions and applying the "hitch-hiker" model for the propagation of light in a medium, the general formula for the light velocity in a moving medium in-

cluding terms of second order in v/c is obtained. This formula is identified with that one obtained by proceeding from the Lorentz transformation. (auth)

16957 STATIONARY AXIALLY SYMMETRIC INTERIOR SOLUTIONS IN GENERAL RELATIVITY. Rawson-Harris, D. (Manchester Univ., Eng.). Int. J. Theor. Phys.; 9: No. 2, 137-138 (Feb 1974).

This note presents the coordinate transformation by which the coordinate condition of a previous paper (Rawson-Harris, Int. J. Theor. Phys.; 6: 53 (1972)) may be imposed. (auth)

16958 REDSHIFT FORMULAE FOR DE-SITTER TYPE METRICS. Lord, E. A. (Inst. of Science, Bangalore, India). Int. J. Theor. Phys.; 9: No. 2, 129-135(Feb 1974).

Redshift formulae are obtained for the three Robertson–Walker solutions of $R_{\mu\nu} = Ag_{\mu\nu}$ by methods based on the geometry of a hyperquadric in five-space. The possibility that the solutions may have validity for the real Universe is justified by an appeal to Hoyle–Narlikar theory (Proc. Roy. Soc.; A273: 1 (1963)). (auth)

16959 GEOMETRY OF THE DE-SITTER UNIVERSE. Lord, E. A. (Inst. of Science, Bangalore, India). Int. J. Theor. Phys.; 9: No. 2, 117-127(Feb 1974).

By making use of the fact that the de-Sitter metric corresponds to a hyperquadric in a five-dimensional flat space, it is shown that the three Robertson–Walker metrics for empty spacetime and positive cosmological constant, corresponding to 3-space of positive, negative, and zero curvative, are geometrically equivalent. The 3-spaces correspond to intersections of the hyperquadric by hyperplanes, and the time-like geodesics perpendicular to them correspond to intersections by planes, in all three cases. (auth)

16960 RELATIVE-DISTANCE MACHIAN THEORIES. Barbour, J. B. Nature (London); 249: No. 5455, 328-329(24 May 1974).

It is stated that Mach's principle, in essence, requires that the dynamical picture of the Universe be expressed in terms only of the relative distances between observable entities. A general framework is here proposed for constructing theories that satisfy this requirement automatically, and a simple model is proposed showing how the Newtonian world could be satisfactorily "Machianized". The approach is stated to reverse the priorities that Einstein had in mind when constructing the theory of general relativity. An aim is to construct theories that are Machian of necessity and then find if any give rise to special relativity. The model discussed explains inertia solely in terms of relative distances and relative velocities and demonstrates that a complete dynamical picture can be expressed in such terms. It is concluded that if this general framework is the right approach to the problem of inertia, radical changes in theoretical physics are almost certainly necessary. (UK)

16961 MINI-BANGS IN COSMOLOGY AND ASTROPHYSICS. Narlikar, J. V. (Tata Inst. of Fundamental Research, Bombay). Pramana; 2: No. 3, 158-170(Mar 1974).

The ideas originally proposed to discuss continuous creation of matter are reconsidered in the context of the big-bang cosmological models. It is shown that singularity-free big-bang models are possible under the modified field equations of general relativity. However, the case is made out that matter creation takes place in several mini-bangs at different epochs rather than in one big bang. The implications of this idea for high-energy astrophysics and for gravitational radiation are discussed. (auth)

16962 PRIMEVAL TURBULENCE FROM MATTER-ANTIMATTER ANNIHILATION. Dallaporta, N.; Danese, L.; Lucchin, F. (Padua Univ. (Italy)). Astrophys. Space Sci.; 27: No. 2, 497-512(Apr 1974).

In a previous work, the main difficulties of the theory of galaxy formation from universal primordial cosmic turbulence were focussed; it was mainly found that the decay of the turbulence was so strong during the plasma era that turbulence should have been almost completely washed out before recombination, unless, and only for low-density universes, unlikely large turbulent velocities were postulated at the largest scale of the turbulence at the end of the radiation era. It was suggested that a possibility to turn around such a difficulty should consist in finding an adequate physical energy source feeding the turbulence during at least the whole plasma phase. The present work is intended to test whether matter-antimatter annihilation theory at the origin of the universe, as it is developed by Omnes and his collaborators, may be considered to yield the required energy source of the turbulence. To this aim, the main results of the work of Stecker and Puget concerning the behaviour of the most important quantities of the matter-antimatter annihilation theory are used, in order to describe the properties of the energy source for the turbulence down to recombination time, and extended to take a somewhat more detailed account of their z and mean matter density dependences. The energy feeding source thus obtained is then introduced into the general framework of the galaxy formation theory from cosmic turbulence taking account of energy dissipation as developed in the previous works. The results obtained concerning the comparison of the main parameters of galaxies derived from the theory with the experimental data are much more satisfactory than in the previous approach, and show that, inside the errors of the present day values, sufficiently good fits are possible in a range of mean universe densities between 0.4 to 1 times the critical density. (auth)

16963 NUCLEAR ENERGY IN THE COSMOS. de Graaf, T. (Rijksuniversiteit Groningen (Netherlands)). Atoomenerg. Haar Toepass.; 16: No. 4, 81-86(Apr 1974). (In Dutch).

A graph is given of the relative abundance of elements in the cosmos, plotted against their atomic weights up to 200. There are clear peaks for the iron group, and in the regions of atomic weights 90, 140, and 200. These are associated with the magic numbers 28, 50, 82, and 126 for the atomic number. Various possibilities are mentioned for the sources of these elements, e.g., little bangs, big bangs, cosmic radiation. A scheme is shown to account for the formation of new molecules by cosmic synthesis, and many unstable nuclei (e.g., ^{3}He, ^{7}Li) appear to be so formed. The part played by the black hole (predicted by Einstein) is not yet understood. (NL)

16964 TETRAD FIELD EQUATIONS AND A GENERALIZED FRIEDMANN EQUATION. Tupper, B. O. J. (New Brunswick Univ., Fredericton (Canada). Dept. of Mathematics). Astrophys. Space Sci.; 28: No. 1, 225-231(May 1974).

The tetrad field equations of general relativity discussed in previous articles are applied to Robertson–Walker cosmological models. A generalized Friedmann equation is derived and some of its consequences are discussed. (auth)

Planetary Phenomena

Refer also to abstract 17021.

16965 (CONF-740321-3) SOME SURFACE PROPERTIES OF APOLLO 17 SOILS. Holmes, H. F.; Fuller, E. L. Jr.; Gammage, R. B. (Oak Ridge National Lab., Tenn. (USA)). 1974. 23p. Dep. NTIS $4.25.

From 5th lunar science conference; Houston, Texas, USA (18 Mar 1974).

The surface chemistry of Apollo 17 lunar fines samples 74220 (the orange soil) and 74241 (the gray control soil) was studied by measuring the adsorption of nitrogen, argon, and oxygen (all at 77°K) and also water vapor (at 20 or 22°C). In agreement with results for samples from other missions, both samples had low initial specific surface areas, consisted of nonporous particles, and were attacked by water vapor at high relative pressures to give an increased specific surface area and create a pore system which gave rise to a capillary condensation hysteresis loop in the adsorption isotherms. In contrast to previous samples, both of the Apollo 17 soils were partially hydrophobic in their initial interaction with water vapor (both samples were completely hydrophilic after the reaction with water). The results are consistent with formation at high temperatures without subsequent exposure to significant amounts of water. (auth)

16966 U, Th, Pu FRACTIONATION IN GEOLOGIC SYSTEMS: EARLY Pu–U ABUNDANCE IN METEORITES. Seitz, M. G. (Singer Co., Silver Spring, MD). Trans. Amer. Nucl. Soc.; 18: 87-88(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

16967 OBSERVATIONS OF HD ON JUPITER AND THE D/H RATIO. Trauger, J. T. (Univ. of Wisconsin, Madison); Roesler, F. L.; Carleton, N. P.; Traub, W. A. Astrophys. J.; 184: No. 3, L137-L141(15 Sep 1973).

A measurement of the HD (7467 Å) 4-0 P(1) absorption line on Jupiter is reported and, by comparison with the H_2 (6367 Å) 4-0 S(1) line, a nearly model-independent number ratio [D]/[H] = $(2.1 \pm 0.4) \times 10^{-5}$ was determined for the Jovian atmosphere. (auth)

16968 ^{40}Ar–^{39}Ar AGES AND TRACE ELEMENT CONTENTS OF APOLLO 14 BRECCIAS: AN INTERLABORATORY CROSS-CALIBRATION OF ^{40}Ar–^{39}Ar STANDARDS. Alexander, E. C. Jr.; Davis, P. K. (Univ. of California, Berkeley). Geochim. Cosmochim. Acta; 38: No. 6, 911-928(Jun 1974).

Rare-gas data are presented from step-wise heatings of lunar breccias 14066 and 14318 and from an interlaboratory cross-calibration of five standards used in ^{40}Ar–^{39}Ar dating. Four samples of 14066 all show depressed ^{40*}Ar/^{39*}Ar ratios at high

temperatures, thus making age interpretation uncertain. While different in detail, the Ar release patterns in the four samples yield indistinguishable plateau ages of 3.93 ± 0.03 b.y. and >400°C total ages of 3.87 ± 0.06 b.y. Concentrations of K, Ca, Ba, Br, U, and I are given for 14318 and 14066. An updating is presented of all of the $^{40}Ar-^{39}Ar$ ages and trace-element concentrations previously published by the authors' laboratory. $^{40}Ar-^{39}Ar$ datfng standards from Menlo Park, Pasadena, Stony Brook, Toronto, and Berkeley are calibrated against each other and the internal homogeneity of their $^{40*}Ar/K$ ratios is tested. The Berkeley standard (from the St. Severin meteorite) has an age of 4.504 ± 0.020 b.y. from this intercalibration. ^{80}Kr from capture of lunar neutrons is detected in 14318. A comparison of the release pattern of the ^{80}Kr produced by lunar neutrons with the $^{80,82}Kr$ produced by pile neutrons in 14318, indicates that 14318 has lost approximately 35 percent of the ^{80}Kr produced by lunar neutrons. (auth)

16969 INTENSITIES OF THE 3-0 AND 4-0 ROTATIONS-VIBRATION BANDS OF HD. McKellar, A. R. W. (National Research Council of Canada, Ottawa). Astrophys. J.; 185: No. 1, L53-L55(1 Oct 1973).

Laboratory intensity measurements of the R (0) absorption lines in the weak 3-0 and 4-0 dipole-allowed bands of hydrogen deuteride have been made. The measurements enable HD, and hence deuterium, abundances to be determined for planetary atmospheres from observations of HD lines in planetary spectra; one such observation has recently been made in the spectrum of Jupiter. The pressure broadening of the HD lines by H_2 has been determined, and this should also be useful in the interpretation of planetary spectra. (auth)

16970 ELECTRONS AND PROTONS ACCELERATED IN MERCURY'S MAGNETIC FIELD. Simpson, J. A.; Eraker, J. H.; Lamport, J. E.; Walpole, P. H. (Univ. of Chicago). Science; 185: No. 4146, 160-166(12 Jul 1974).

Fluxes of protons with energies of ~550 keV and electrons with energies of ~300 keV which exceed approximately 10^4 and 10^5 cm^{-2} sec^{-1}, respectively, were discovered in the magnetosphere of Mercury. Electron fluxes >10^3 cm^{-2} sec^{-1} also were observed in the outbound pass of the Mariner 10 spacecraft through the magnetosheath. (WDM)

16971 MAGNETIC FIELD OBSERVATIONS NEAR MERCURY: PRELIMINARY RESULTS FROM MARINER 10. Ness, N. F. (Goddard Space Flight Center, Greenbelt, MD); Behannon, K. W.; Lepping, R. P.; Whang, Y. O.; Schatten, K. H. Science; 185: No. 4146, 151-160(12 Jul 1974).

Results are presented from a preliminary analysis of data obtained near Mercury on March 29, 1974 by the NASA-GSFC magnetic-field experiment on Mariner 10. Rather unexpectedly, a very well-developed, detached bow shock wave, which develops as the super-Alfvénic solar wind interacts with the planet, has been observed. In addition, a magnetosphere-like region, with maximum field strengths of 98 gammas at closest approach (704 kilometers altitude), has been observed, contained within boundaries similar to the terrestrial magnetopause. The obstacle deflecting the solar-wind flow is global in size, but the origin of the enhanced magnetic field has not yet been uniquely established. The field may be intrinsic to the planet and distorted by interaction with the solar wind. It may also be associated with a complex induction process whereby the planetary interior–atmosphere–ionosphere interacts with the solar-wind flow to generate the observed field by a dynamo action. The complete body of data favors the preliminary conclusion that Mercury has an intrinsic magnetic field. If this is correct, it represents a major scientific discovery in planetary magnetism and will have considerable impact on studies of the origin of the solar system. (auth)

16972 OBSERVATIONS AT MERCURY ENCOUNTER BY THE PLASMA SCIENCE EXPERIMENT ON MARINER 10. Ogilvie, K. W. (Goddard Space Flight Center, Greenbelt, MD); Scudder, J. D.; Hartle, R. E.; Siscoe, G. L.; Bridge, H. S.; Lazarus, A. J. Science; 185: No. 4146, 145-151(12 Jul 1974).

A fully developed bow shock and magnetosheath were observed near Mercury, providing unambiguous evidence for a strong interaction between Mercury and the solar wind. Inside the sheath there is a distinct region analogous to the magnetosphere or magnetotail of Earth, populated by electrons with lower density and higher temperature than the electrons observed in the solar wind or magnetosheath. At the time of encounter, conditions were such that a perpendicular shock was observed on the inbound leg and a parallel shock was observed on the outbound leg of the trajectory, and energetic plasma electron events were detected upstream from the outbound shock crossing. The interaction is most likely not atmospheric, but the data clearly indicate that the obstacle to solar wind flow is magnetic, either intrinsic or induced. The particle fluxes and energy spectra showed large variations while the spacecraft was inside the magnetosphere, and these variations could be either spatial or temporal. (auth)

16973 THE SUBSTRUCTURE IN THE HEADS OF COMETS WITH TYPE I AND TYPE II TAILS. Wurm, K. (Asiago Observatory, Italy). Astrophys. Space Sci.; 27: No. 1, 211-216(Mar 1974).

On a number of Comet Halley 1910 photographs of short exposures (Helwan material) a substructure in dust emission in the inner coma becomes detectable. Narrow and diffuse dust streamers leave the nucleus area within a smaller or larger cone opened in the direction to the Sun. On plates with longer exposures these structures merge together in a parabolic envelope. Structures of the type I tail are not visible for lower heliocentric distances (r < 1) in the inner coma; however, occasionally CN, C_2 eject circular emission areas. (auth)

16974 DUST EMISSION STRUCTURE IN COMETS WITH TYPE II TAILS. Benvenuti, P. (Asiago Astrophysical Observatory, Italy). Astrophys. Space Sci.; 27: No. 1, 203-209(Mar 1974).

Short exposure plates of Comet Arend-Roland (1956h) are examined and compared with similar photographs of Comet Bennett (1969i), Comet Halley (1910 II) and Comet Mrkos (1957d). It is found that the emission structure of the dust near the nucleus in the first comet is different from that in the others, although in all cases there is formation of parabolic envelopes. Close resemblances with configurations described by Wurm and Mammano (1972) have been found for Comet Halley and Comet Mrkos. (auth)

16975 ON THE FORMATION OF JUPITER AND SATURN. Kumar, S. S. (Virginia Univ., Charlottesville (USA)). Astrophys. Space Sci.; 28: No. 1, 173-176(May 1974).

It is proposed that Jupiter and Saturn were initially formed as small rocks which grew into their present sizes as a result of accretion of matter from the gas–dust cloud surrounding the Sun. The energy released by the accretion of Jupiter and Saturn is computed. It is concluded that the "excess" radiation from these planets is due to simple cooling and that the gravitational contraction from initially extended states most probably never occurred. (auth)

16976 ATMOSPHERIC ION WAKES OF VENUS AND MARS IN THE SOLAR WIND. Cloutier, P. A.; Daniell, R. E.; Butler, D. M. (Rice Univ., Houston, TX). Planet. Space Sci.; 22: No. 6, 967-990(Jun 1974).

A model has been developed for the currents induced in the ionospheres of Venus and Mars by the flowing magnetized solar wind in a previous paper (Cloutier and Daniell, Planet. Space Sci.; 21: 463 (1973)). The altitudes of the ionopauses on both planets, determined from the electrodynamical models of the previous paper, are used here to calculate the total rates of atmospheric mass loss to the solar wind for Venus and Mars. These loss rates are compared to the rates calculated by Michel (Rev. Geophys.; 9: 422-35 (1971) and Planet. Space Sci.; 19: 1580 (1971)) based upon the limit of mass loading of the solar-wind flow determined from hydrodynamic constraints. The distributions of planetary ions in the downstream wakes of Venus and Mars are calculated, and the interpretation of ion spectrometer measurements from close planetary encounters is discussed. (auth)

PHYSICS (ATMOSPHERIC)

16977 (ANL-8080, pp 7.1-7.7) METEOROLOGICAL EFFECTS OF HIGH ENERGY PARTICLE BEAMS IN THE ATMOSPHERE. Martin, R. L. (Argonne National Lab., IL). 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

The effects of high energy particle beams in the atmosphere discussed include the triggering of a lightning discharge and the subsequent local heavy rain gush as well as weather modification possibilities. (JFP)

Auroral and Ionospheric Phenomena

Refer also to abstract 15275.

16978 (COO-2059-35) EXISTENCE AND STABILITY OF STRONG POTENTIAL DOUBLE LAYERS. Knorr, G.; Goertz, C. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Mar 1974. Contract AT(11-1)-2059. 37p. Dep. NTIS $5.00.

An elementary integral equation technique is used to construct strong and weak stationary shock solutions from the one-dimensional Vlasov equation. It is shown that the plasma is Penrose stable in all points in space under certain conditions. (auth)

16979 (NP-20041) PROPOSAL FOR EUROPEAN INCOHERENT SCATTER FACILITY IN THE AURORAL ZONE (EISCAT). Castel, F. du; Holt, O.; Hultqvist, B.; Kohl, H.; Tiuri, M. (Centre National d'Etudes des Telecommunications (CNET), 92 – Issy-les-Moulineaux (France); Kungliga Vetenskapsakademien, Kiruna (Sweden). Geofysiska Observatoriet; Max-Planck-Institut fuer Aeronomie, Lindau/Harz (F. R. Germany); Helsinki Univ. of Technology, Otaniemi (Finland); Auroral Observatory, Tromsoe (Norway)). Jun 1971. 79p. Dep. NTIS (US Sales Only) $6.75.

The study presents a project for an incoherent scatter facility situated in the European auroral zone. It will be financed and operated by research organizations in Finland, France, Germany, Norway, and Sweden. The transmitter will be situated in the Tromsø area, and the receivers near Sodankylä and Kiruna. Following a general introduction outlining the proposed system and its advantages, the incoherent scatter technique and the measurements which can be made are described. The scientific objectives and the requirements are then discussed. The design of the facility and choice of frequencies, its characteristics and performance are presented. The locations of the transmitter and receiving stations are considered with the aid of maps. Finally the financing and administration are presented. (NO)

16980 (PSU-IRL-SCI-401) PROCEEDINGS OF THE CONFERENCE ON THEORETICAL IONOSPHERIC MODELS, UNIVERSITY PARK, PENNSYLVANIA, JUNE 14–16, 1971. Nisbet, J. S. (ed.). (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). 28 Sep 1972. 399p. (CONF-710669-).

This report describes a Conference on Theoretical Ionospheric Models held by the Ionosphere Research Laboratory of The Pennsylvania State University at University Park, Pennsylvania, from June 14–16, 1971. The Conference was intended to lay the groundwork for the development of the next generation of theoretical ionospheric models. (auth)

16981 (TT-74-50011, pp 194-196) COSMOGONIC SODIUM-22 AND BERYLLIUM-7 ISOTOPES IN INVESTIGATIONS OF ATMOSPHERIC DYNAMICS. Luyanas, V. Yu.; Yasyulenis, R. Yu.; Styro, B. I. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The possibility of using the ratio of concentrations of the cosmogonic radioisotopes ^{22}Na and ^{7}Be for determining the penetration of stratospheric air to the Earth's surface is examined. The measurements were carried out at Elektrenai and Vilnius between 1965 and 1969. In some cases, the $^{22}Na/^{7}Be$ ratio reached values that were typical of stratospheric air. It is preferable to use a pair of isotopes of which one has a lifetime of several years, to study the air exchange between the stratosphere and troposphere. (auth)

16982 (TT-74-50011, pp 208-212) SEASONAL BERYLLIUM-7 VARIATIONS IN GROUND LEVEL AIR. Gedeonov, L. I.; Gritchenko, Z. G.; Flegontov, V. M. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

The content of cosmogonic ^{7}Be in ground level air and atmospheric precipitation was determined in 1960–1968 in the environs of Leningrad from the γ-radiation with the aid of a scintillation and a Ge(Li) drift gamma-spectrometer. In periods when the atmosphere was cleansed of short-lived radionuclides of artificial origin, ^{7}Be was determined in daily samples of atmospheric aerosols filtered from the air. It was found that ^{7}Be in ground level air sometimes varied tenfold from day to day. A great amount of experimental material was collected in the seven years of observations and an average curve was plotted of the mean-monthly variation of ^{7}Be concentration. ^{7}Be, continuously being formed in the troposphere, is apparently the constant component, with superimposed periodic components due to seasonal ^{7}Be penetration from the stratosphere, attaining great values in summer. A statistical analysis of the variable component showed that it is well described by a Gauss function of type $P(t) \sim e^{-t^2/2\sigma^2}$, where t is the number of days elapsed from the peak ^{7}Be concentration in the ground level air, and $\sigma = 60 \pm 2$ days is the parameter of the Gaussian distribution. ^{7}Be concentration in ground level air is highest every June, $(9 \pm 1)\cdot10^{-14}$ curie/m^3, and lowest in December, $(3.5 \pm 1)\cdot10^{-14}$ curie/m^3. There is a 3-to-2 ratio of the overall number of ^{7}Be atoms in ground level air arriving from the stratosphere to those arriving from the troposphere. A constant average of $(4.6 \pm 0.2)\cdot10^{-5}$ atom of ^{7}Be is deposited annually per square centimeter of ground in the Leningrad area. (auth)

16983 (TT-74-50011, pp 213-215) CONCENTRATION OF SODIUM RADIOISOTOPES IN THE GROUND LAYER OF THE ATMOSPHERE AND IN PRECIPITATION. Yasyulenis, R. Yu.; Luyanas, V. Yu.; Styro, B. I. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Measurements of sodium isotope concentrations in rainwater are examined. The sodium was extracted with KU-2 cationite. ^{22}Na was measured from the positronic radiation, and ^{24}Na from beta-gamma coincidences. The ratios of ^{22}Na and ^{24}Na concentrations in the same rainwater sample were found to be 70 and 120. The measured ratios are compared with theoretical evaluations of the concentration ratios in the air. (auth)

16984 (TT-74-50011, pp 216-219) CONCENTRATION OF PHOSPHORUS RADIOISOTOPES IN THE GROUND LAYER OF THE ATMOSPHERE AND IN PRECIPITATION. Shopauskene, D. A.; Shvedov, V. P. 1969. Translated from Russian.

From all-union conference on nuclear meteorology; Obninsk, USSR (23 Jun 1969).

Results of systematic measurements of ^{32}P and ^{33}P concentrations are reported. The measurements were carried out in 1967–1969 in the areas of Vilnius, Lithuania and Cornesti (Moldavian SSR). The maximum values reached $13.8\cdot10^{-15}$ curie/m^3 for ^{32}P and $3.6\cdot10^{-15}$ curie/m^3 for ^{33}P; the minima did not exceed 0.4 and $0.15\cdot10^{-15}$ curie/m^3, respectively, in air samples taken from the ground layer of the atmosphere. The average ^{32}P concentration in atmospheric precipitation was $0.47\cdot10^{-12}$ curie/liter at Vilnius; in samples taken from torrential rains at Cornesti the ^{32}P concentration reached $10.9\cdot10^{-15}$ curie/liter. (auth)

16985 ENERGY AND PITCH ANGLE DISTRIBUTIONS FOR AURORAL IONS USING THE CURRENT SHEET ACCELERATION MODEL. Jaeger, E. F. (National Center for Atmospheric Research, Boulder, Colo. (USA)); Speiser, T. W. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics). Astrophys. Space Sci.; 28: No. 1, 129-144(May 1974).

Using a dipole plus tail magnetic field model, H^+, He^{++}, and O^{+}_{16} ions are followed numerically, backward in time, from an output plane perpendicular to the axis of the geomagnetic tail, to their point of entrance to the magnetosphere as solar wind particles in the magnetosheath. An adiabatic or guiding center approximation is used in regions where the particles do not interact directly with the current sheet. A Maxwellian distribution with bulk flow is assumed for solar wind particles in the magnetosheath. Bulk velocity, density, and temperature along the magnetopause are taken from the fluid calculations of Spreiter. Using Liouville's theorem, and varying initial conditions at the output plane, the distribution function is found as a function of energy and pitch angle at the output plane. These results are then mapped to the auroral ionosphere using guiding center theory. Results show that the total precipitation rate is sufficient only for particles which enter the magnetosphere near the edges of the current sheet. Small pitch angles are favored at the output plane, but mappings to the auroral ionosphere indicate isotropic pitch angle distributions are favored with some peaking of the fluxes parallel or at

other angles to the field lines. Perpendicular auroral pitch angle anisotropies are at times produced by the current sheet acceleration mechanism. Therefore, caution must be used in interpreting all such observations as "loss cone-trapping" distributions. Energy spectra appear to be quite narrow for small cross-tail electric fields, and a little broader as the electric field increases. Comparisons of these results with experimental observations are presented. (auth)

16986 KINEMATICS AND GEOMETRY OF IONOSPHERIC IRREGULARITIES FROM SIMULTANEOUS MEASUREMENTS ON TWO MAGNETOIONIC COMPONENTS. Kashin, A. A.; Lan, N. B. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 6, 722-723 (1973). (In Russian).

The analysis of simultaneous measurements on two magnetoionic components of the ionosphere showed that the kinematics of the irregularities do not depend on the observation selection of the magnetoionic component. Changes in the dynamic conditions in the ionosphere, coinciding with seasonal and yearly changes, do not affect the results of the measurement of the diffraction diagrams on the Earth for each magnetoionic component. The difference detected and its anisotropy is not connected with the ionospheric dynamics and appears to be the result of the scattering of radiowaves in the presence of a stabilizing role of the Earth's magnetic field and the formation of ionization irregularities. (JSR)

16987 IONISATION LEDGES IN THE EQUATORIAL IONOSPHERE. Raghavarao, R.; Sivaraman, M. R. (Physical Research Lab., Ahmedabad, India). Nature (London); 249: No. 5455, 331-332(24 May 1974).

Cusp formation on topside ionograms have been recorded at equatorial latitudes by the satellite Alouette I. The cusps are associated with an ionization ledge lying along the magnetic field line passing through the peaks of the equatorial anomaly. Observations of cusps associated with echoes reflected from a feature aligned with the field below the anomaly field line are here and it is suggested how the ledge of ionization described in the equatorial topside ionosphere may be formed. (auth)

16988 CONCERNING THE ELECTRON TEMPERATURE DISCREPANCY BETWEEN IN SITU AND REMOTE PROBES IN THE E-REGION. D'Arcy, R. J.; Sayers, J. (Birmingham Univ., Eng.). Planet. Space Sci.; 22: No. 6, 961-966(Jun 1974).

Rocket-borne Langmuir probe measurements of electron temperature in the E region are examined in relation to recent laboratory investigations of surface drift effects which can lead to erroneously high and time-dependent electron temperature measurements. The rocket data is consistent with the laboratory expectations thus supporting the suggested importance of surface effects in rocket measurements and in relation to the E-region discrepancy with simultaneous incoherent radar scatter measurements. (auth)

16989 RESULTS FROM A SWEPT-FREQUENCY IONOSPHERIC IMPEDANCE PROBE. Miller, E. K.; Schulte, H. F. (Univ. of California, Livermore). Planet. Space Sci.; 22: No. 6, 1017-1030(Jun 1974).

Experimental results are presented for the impedance of a rocket-borne dipole antenna immersed in the ionospheric plasma. The dependence of several interesting impedance artifacts upon the antenna position relative to the Earth's magnetic field and rocket motion through the ionospheric plasma is shown. Possible evidence for plasma compressibility is provided by an impedance discontinuity occurring consistently at approximately twice the electron cyclotron frequency and a frequency shifted cyclotron-resonance impedance minimum. (auth)

16990 FLUCTUATIONS OF ELECTRON PRECIPITATION TO THE DAYSIDE AURORAL ZONE MODULATED BY COMPRESSION AND EXPANSION OF THE MAGNETOSPHERE. Saito, T.; Takahashi, F.; Morioka, A.; Kuwashima, M. (Tohoku Univ., Sendai, Japan). Planet. Space Sci.; 22: No. 6, 939-953(Jun 1974).

Concurrent variations of CNA fluctuations and geomagnetic fluctuations are classified into Type 1 (substorm-type), Type 2 (Pc5-type), and Type 3 which is the object of the present study. Type 3 apparently has peculiar characteristics in that CNA fluctuations at a certain auroral-zone station show a pronounced positive correlation with magnetic fluctuations at distant low-latitude stations. The magnetic fluctuations of this type are identified to generalized Si which tends to take place much more frequently than the so-called Si. The CNA fluctuations of this type are found to take place on the dayside auroral zone only when preceded by a magnetic substorm on the night side. Considering the change of the growth rate of electron cyclotron instability and enhancement of pitch angle diffusion due to the change of magnetic field intensity, the following model is proposed to explain the occurrence mechanism of Type 3 concurrent variations. The CNA fluctuations take place only when two conditions are satisfied; generation of the accelerated electrons in association with substorm onset and modulation of the precipitation of the electrons by compression and expansion of the magnetosphere, in other words, by generalized Si. (auth)

16991 ATMOSPHERIC EXPANSION FROM JOULE HEATING. Bates, H. F. (Alaska Univ., College). Planet. Space Sci.; 22: No. 6, 925-937(Jun 1974).

An expression for the vertical velocity of the neutral atmosphere in the F region is derived for Joule heating by the electric field that drives the auroral electrojet. When only vertical expansion is allowed, it is found that the vertical wind must always increase monotonically with altitude. The heating rate is proportional to the F-region ion density, so that appreciable heating, even during high electric fields, requires some production mechanism of ionization such as auroral secondary ionization or solar photoionization, in the lower F region. Once started at night, when an ionizing source is present in the lower F region, the expansion of the atmosphere transports ionization upward, thereby increasing the heating rate, and hence the expansion rate, i. e. positive feedback. Electric field strengths and F-region ion densities of 50 mV/m and 2×10^{11} e/m^3, respectively, will produce vertical neutral wind speeds of several tens of m/sec in the 300 to 500 km altitude range. During periods of high magnetic activity, i.e. high electric field, Joule heating can produce large increases in the relative N_2 concentration in the upper F region; computations made with a simple model suggest that tenfold increases can occur at 400 km altitude ½ to 1 hr after the onset of magnetic activity, a result in agreement with satellite observations. When the Joule heating theory is applied to incoherent scatter data taken during one period of high heating, the horizontal electric field in the F region is found to decrease markedly, possibly approaching zero as the field penetrates a weak, discrete auroral arc; the decrease began 10 to 20 km from the arc. (auth)

16992 SIMPLIFIED METHOD FOR CALCULATION OF THE EFFECTS OF TRANSEQUATORIAL ELECTRON FLUXES ON THE EQUATORIAL F2-REGION. Heelis, R. A.; Moffett, R. J.; Windle, D. W. (Sheffield Univ., Eng.). J. Atmos. Terrest. Phys.; 36: No. 8, 1387-1394(Aug 1974).

Calculation of electron distributions in the equatorial F2 region under asymmetrical conditions requires a large amount of computing time. To reduce this time, boundary conditions at 750 km are developed so that integration of the equations is not required in the region above 750 km. For the computing configuration used, the time is reduced by a factor of about 6. The results compare favorably with those from calculations using complete field lines. A further advantage of the method is that numerical integration of the equations remains stable for greater values of the height of the equatorial crossing point of the field line. (auth)

16993 THEORETICAL STUDY OF NEGATIVE-ION CHANGES IN THE D-REGION DURING AN ECLIPSE. Thomas, L.; Bowman, M. R. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 36: No. 8, 1411-1420(Aug 1974).

A negative-ion model has been used to examine the changes in negative-ion composition and concentration during an eclipse, and their role in determining the corresponding variations in electron concentration. Particular attention is paid to the effects of the photo-detachment of electrons from major negative ions, and to the influence of changes in concentrations of atomic oxygen, ozone and the first electronically excited state of molecular oxygen during the eclipse. (auth)

16994 ELECTRON PRECIPITATION IN A NON-UNIFORM GLOW AURORA. Courtier, G. M.; Bryant, D. A. (Science Research Council, Slough, Eng.). Planet. Space Sci.; 22: No. 7, 1067-1074(Jul 1974).

Electron intensities at 5 keV, >18 keV, and >45 keV, were measured on a Petrel rocket flown from Kiruna, Sweden, into a non-uniform glow aurora during the recovery phase of a magnetic bay. The intensities depend on pitch-angle in a way that is consistent with the precipitation being caused by pitch-angle diffusion from reservoirs of geomagnetically-trapped electrons. The scattering process that causes pitch-angle diffusion, and leads to three regions of relatively high intensity, appears to have properties different from the scattering process that leads to two intervening regions of low intensity. A spatial structure in electron reservoir intensity, is attributed mainly to variations in the rate of erosion by pitch-angle diffusion of an initially nearly-uniform reservoir intensity. An expression is derived for the minimum lifetime of trapped electrons undergoing strong pitch-angle diffusion. (auth)

16995 ABOUT THE EFFECTS INDUCED BY THE DAILY VARIATION DUE TO THE EQUATORIAL ELECTROJET. Mayaud, P. N. (Univ., Paris). J. Atmos. Terrest. Phys.; 36: No. 8, 1367-1376(Aug 1974).

There exists an apparent conflict between one of the main conclusions of the series of papers on "POGO-observations of the equatorial electrojet" (variable induced effects either are the source of the differences, with longitude, of the surface/satellite ratios of the electrojet effects or contribute to the longitude variation of the average amplitude, at satellite-level, of the electrojet) and a result obtained by Fambitakoye (1972, 1973) from a chain of stations in Central Africa (the daily variation due to the electrojet has negligible induced effects). It is pointed out that the apparent differences, with longitude, of the surface/satellite ratios have been overestimated; they are within the margin of possible errors. On the other hand, in addition to ionospheric conductivities, other external factors have to be taken into account before calling for variable induced effects, in order to explain the longitude variation at satellite level. Finally it is shown that the use of surface/satellite ratio is misleading, because the method implies that the values obtained are twice as large as they should be. The conflict mentioned above thus disappears and the POGO results do not invalidate the result of Fambitakoye. (auth)

16996 MEASUREMENTS OF ATMOSPHERIC ABSORPTION IN THE THERMOSPHERE WITH SATELLITES. Felske, D.; Knuth, R.; Lippert, W.; Sonnemann, G. (Deutsche Akademie der Wissenschaften, Berlin). J. Atmos. Terrest. Phys.; 36: No. 8, 1355-1366(Aug 1974).

Solar x-ray measurements in the range 8 to 16 Å in a satellite are used to determine the atmospheric absorption during sunrise and sunset at heights between 100 and 200 km. This height range can be investigated by other geophysical methods only with great difficulties and restrictions. Model investigations on a wide band of different sources influencing the absorption cross section are described. On the basis of observations from June 1969 till April 1971 and for geographical latitudes of 45° to 60°N the following conclusions for neutral gas density can be drawn: (1) In winter the density variations are smaller and more stable than in summer. (2) Temperatures and scale heights in general are in good accordance with CIRA 72 models. The temperatures seem to be somewhat higher below 120 km in summer and lower above 140 km in winter. (3) A remarkable 27-day variation is present, but the time lag behind solar activity reaches 5 days. (4) Below 150 km the annual variation with density maximum in winter seems to be more pronounced than the semi-annual variation. (auth)

16997 EQUATORIAL IONOSPHERIC ABSORPTION DURING HALF A SOLAR CYCLE (1964–1970). Gnanalingam, S. (Ceylon Inst. of Scientific and Industrial Research, Colombo). J. Atmos. Terrest. Phys.; 36: No. 8, 1335-1354(Aug 1974).

An extensive series of vertical incidence absorption measurements made at an equatorial station is analyzed in detail to provide information which will lead to a better understanding of the lower ionosphere. A quantitative empirical relationship is derived between absorption and 1 to 8 Å solar flux for moderate levels of solar activity. It is shown that the threshold flux for D-region modification, at a solar zenith angle of 10°, is approximately 0.5×10^{-3} erg cm^{-2} sec^{-1}. Attention is drawn to the incidence of days of high absorption even in the absence of solar x-ray activity. Available evidence points to variability of the order of 10 to 40 per cent in the intensity of the solar Lyman-α radiation as the most likely cause of these unusual, though infrequent, enhancements in absorption. The influence of geomagnetic storms on equatorial absorption is found to be insignificant, both at solar minimum and at solar maximum. In the diurnal variation of absorption, the maximum absorption occurs about 20 to 30 min after the time of minimum solar zenith angle. This time-lag is almost an order of magnitude larger than the time-lag expected on the basis of current estimates of the effective recombination coefficient for the lower ionosphere. From the zenith angle dependence of the diurnal variation of absorption it is possible to predict the seasonal variation of the noon absorption. However, when this is done, significant departures from the predicted values are observed at the solstices. (auth)

16998 AUSTRALIAN SPACE RESEARCH, 1973. Report to the Seventeenth Meeting of COSPAR at Sao Paulo, Brazil, June 1974 by the Australian National Committee for Space Research. Canberra, Australia; Australian Academy of Science (1974). vp.

The space research programs of universities and government departments are reported. Studies include ionospheric phenomena, weather, upper atmosphere photochemistry, cosmic radio sources, ozone profiles, chemical seeding, and a sounding rocket program. (AU)

16999 PHYSICS OF THE IONOSPHERIC PLASMA. The CISASPE Experiment. Beghin, C. (Groupe de Recherches Ionospheriques, Val-de-Marne, France). Rech. Spatial; 12: 27-30(1973). (In French).

External geophysics has made possible in past years an opening toward other disciplines initially partitioned (e.g., the transposition from the laboratory to ionospheric and magnetospheric space of methods of thought, as experimental methods, of plasma physics). In this framework the proper objectives of an experiment on a rocket probe could present two different but complementary aspects: utilization of properties of the plasma to make a local diagnosis as precise as possible, or on the contrary, utilization of the space plasma as an almost perfect laboratory to solve basic problems. It is on these themes that the CISASPE (knowledge of the ionosphere by active probing, mass spectrometry, and preparation of electrostatic waves) experiment was conceived and developed. (IAA)

Effects of Nuclear Detonations

Refer also to abstracts 15383, 15396, and 15400–15402.

Magnetospheric Phenomena

17000 (JINR-P3-7785) METHOD OF ATTENUATION OF THE GEOMAGNETIC FIELD. Taran, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The description is given of the method to attenuate the geomagnetic field (GMF) using a single-layer cylindrical screen of soft-magnetic material magnetized in such a way that the scattered magnetic field compensates, inside the screen, the penetrated and diminished GMF. The screening efficiency is increased experimentally, as compared with that of nonmagnetized screen, by 30 to 150 times depending on the method of magnetization. Two ways are described—current and thermal ones—for obtaining the desired screen magnetization. (auth)

17001 SOLAR WIND FLUX IN THE VICINITY OF THE MAGNETOSPHERIC CAVITY. Perez de Tejada, H. An. Inst. Geofis. UNAM (Univ. Nac. Auton. Mex.); 17: 71-80(1971). (In Spanish).

The region of interaction between the solar wind and the geomagnetic field is examined under the formalism of conventional magnetogasdynamics. A flux model is used to represent the conditions existing in the vicinity of the equatorial magnetosphere. The incident plasma is assumed to have infinite electrical conductivity and a magnetic field aligned in the flux direction. The geomagnetic cavity acts in the first approximation as a solid obstacle immersed in the solar wind with which it interacts collectively. Below these approximations the behavior of the thermodynamic variables of the flux is investigated as a function of the incidence velocity, of the β parameter of the plasma, and of the thermal characteristics of the medium. Particular attention is given to the influence of the magnetic effect on the modification of the conventional patterns of the viscous interaction in hydrodynamics. (tr-auth)

17002 PHASE-BUNCHING AND OTHER NONLINEAR PROCESSES OCCURRING IN GYRORESONANT WAVE-PARTICLE INTERACTIONS. Gendrin, R. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Astrophys. Space Sci.; 28: No. 1, 245-266(May 1974).

The movement of individual electrons in a magnetized plasma in which a monochromatic wave is propagating in the whistler mode is considered. Simple expressions are given which give the displacement of the electrons as a function of time, the phase angle that their velocity vector makes with the magnetic component of the wave, their pitch angle and energy changes. A useful formula is obtained which gives the velocity range over which particles remain trapped inside the wave, as a function of the wave intensity and of the initial phase angle of the particle. It is shown that even strictly resonant particles can escape from the wave when their initial phase angle is very small. From the derived expressions, it is possible to compute the phase-bunching effect which occurs approximately at one trapping wavelength behind the leading edge of the interaction region. The total amount of energy which is taken from (or given to) the wave by magnetospheric electrons in both cases of naturally existing or artificially injected particles is deduced. It is shown that these non-linear amplification processes can lead to very large VLF amplitude in the magnetosphere. (auth)

17003 AURORA AND THE MAGNETOSPHERE. The Chapman Memorial Lecture. Akasofu, S. I. (Alaska Univ., College). Planet. Space Sci.; 22: No. 6, 885-923(Jun 1974).

Magnetospheric physics owes its beginnings to the seventeenth- and eighteenth-century scientists who were fascinated by one of the most spectacular natural phenomena, the aurora. In the first section, a brief historical account of the growth of magnetospheric physics and solar–terrestrial physics is given. The main part of the paper reviews recent progress in magnetospheric physics, in particular, in understanding the magnetospheric substorm. A number of magnetospheric phenomena can now be understood by viewing the solar wind–magnetosphere interaction as an MHD

dynamo; auroral phenomena are powered by the dynamo. The magnetospheric responses to variations of the north–south and east–west components of the interplanetary magnetic field have been identified. The magnetospheric substorm is entirely different from the responses of the magnetosphere to the southward component of the interplanetary magnetic field. It may be associated with the formation of a neutral line within the plasma sheet and with an enhanced reconnection along the line. A number of substorm-associated phenomena can be understood by noting that the new neutral line formation is caused by a short-circuiting of a part of the magnetotail current. (auth)

17004 TEMPORAL VARIATIONS IN THE DAWN AND DUSK MIDLATITUDE TROUGH AND PLASMAPAUSE POSITION. Grebowsky, J. M.; Tulunay, Y. K.; Chen, A. J. (Goddard Space Flight Center, Greenbelt, MD). Planet. Space Sci.; 22: No. 7, 1089-1099(Jul 1974).

The temporal development of the latitudinal position of a 600 km midlatitude electron density trough at dawn and dusk during the period 25 to 27 May 1967, which encompassed a large magnetic storm, was measured by the RF capacitive probe on the polar orbiting Ariel 3 satellite. The substorm-related changes in the L coordinate of the trough minimum and the point of most rapid change of density gradient on the low-latitude side of the trough are similar. Oscillations of the trough position at dusk are in phase with substorm activity whereas movement of the trough at dawn is only apparent with the onset of the large storm. Detailed model calculations of the plasmasphere dynamics assuming a spatially invariant equatorial convection E-field which varies in step with the K_p index produces a plasmapause motion which parallels the observed trough behavior, particularly at dusk, and shows that the outer plasmasphere and possibly the trough region are characterized by complex fine structured variations due to the past history of the magnetosphere convection. (auth)

17005 WHISTLER STUDY OF PLASMAPAUSE MOTION IN THE VICINITY OF SANAE, ANTARCTICA. Woods, A. C.; Scourfield, M. W. J.; Clarence, N. D. (Natal Univ., Durban, South Africa). Planet. Space Sci.; 22: No. 7, 1139-1143(Jul 1974).

For 4 months of synoptic records whistlers have been analyzed in two groups, high latitude (HL) whistlers with $f_n \sim 8$ kHz and low latitude (LL) whistlers with $f_n \sim 8$ kHz. A decrease in percentage occurrence of HL whistlers with increasing K_p is interpreted as being due to equatorwards movement of the plasmapause in the vicinity of SANAE, Antarctica ($L = 4$). The diurnal variation in HL and LL whistler occurrence reveals an average behavior of the plasmapause, namely, an equatorwards movement beginning at around 2000 LT followed by a return movement from 0400 LT to 0800 LT. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

17006 (ORNL-tr-2815) ATOMIC COLLISIONS ON THE SURFACE OF A SOLID BODY. Ayukhanov, A. Kh. (Ed.). (AN Uzbekskoj SSR, Tashkent. Inst. Ehlektroniki). [nd]. Translation of Atomnye Stolknoveniya na Poverkhnosti Tverdogo Tela, Izdatel'stvo FAN Uzbekskoi SSR, Tashkent, 1972. 117p. Dep. NTIS $9.00.

The results of studies on interaction of streams of corpuscular radiation with the surfaces of solid bodies are presented. The phenomena of dispersion, channeling, neutralization of ions, and emission of ions and electrons are considered and the effect of ion bombardment on physico-chemical properties of the surface is discussed. (auth)

17007 NUCLEAR-RADIATION-INDUCED EXCITATION IN HELIUM. Maceda, E. L.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 18: 71-72(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17008 CALCULATION OF CHARGE STATE DENSITIES IN ELECTRON BEAM MULTIPLY CHARGED ION SOURCES. Hertenberger, G.; Roch, K.; Winter, H. (Univ., Vienna). Z. Naturforsch.; 28a: No. 10, 1687-1696(Oct 1973). (In German).

Regarding both step by step and direct ionization by electron impact, and including losses from radiative recombination and charge exchange, a simple model for calculation of charge state densities in electron beam multiply charged ion sources was developed. The diffusion of the created charged particles out of the ionization volume is included in the model. A monoenergetic electron beam of high current density interacts with a gas at a pressure range from 10^{-6} to 10^{-4} torr. The calculations were performed for argon, krypton, and xenon with an impact energy from 2 to 10 keV. Influences of several elementary processes are discussed in regard to developments of new types of multiply charged ion sources. (GE)

17009 LOW-ENERGY ION REFLECTION FROM METAL SURFACES. Suurmeijer, E. P. Th.; Boers, A. L. (Rijksuniversiteit Groningen (Netherlands)). Surf. Sci.; 43: No. 1, 309-352(May 1974).

A review is given of the available information in the field of low-energy (≤30 keV) ion reflection from metal surfaces. Considerable attention is paid to the so-called binary collision approach and its ranges of validity. In addition, the different existing models describing the scattering from a surface, and recent results of experimental verification of them are discussed. (auth)

17010 PROGRESS IN MOLECULAR BEAM STUDIES IN KYOTO UNIVERSITY. II. Kodera, K. (Kyoto Univ.). Shitsuryo Bunseki; 21: No. 3, 203-215(Sep 1973).

The progress in the molecular beam studies carried out at Kyoto University since 1941 is described. From 1941 to 1948, it was hard to do research work on molecular beam because of the war and financial problems after the war. Since 1949, the research work was done at Kyoto Technical University. Scattering of Na beam by He, Ne, Ar, H_2, N_2, CO, O_2, NO and CO_2 was studied. The values of Van der Waals' constant C estimated from these cross sections were reasonable as compared with theoretical ones. In 1961, the measurement of total scattering cross section was begun. With various precautions, it was proved that the dependence of the total cross section Q upon beam velocity corresponded to that of s = 6, and glory undulation was observed for the system K–Xe, where s is a parameter of attractive potential. Experiments on other gases were performed. Reactive scattering was studied with a small and simple crossed beam apparatus without a velocity selector, for the system of K and various halogens and halides. Measurement of the angular distribution of scattered particles (differential cross sections) was performed for K and halogens and halides, with a new apparatus. The velocity of scattered particles was measured in inelastic scattering including reactive scattering. The experiment was carried out for the purpose of determining the residence time of K atoms on tungsten surface by means of TOF technique. The interaction of the molecular beam with solid surfaces was investigated with K beam. The cross beam method was applied to the study of chemiluminescent reactions O + NO and H + NO. (Kato, T.)

17011 ELECTRON-PHONON SCATTERING TIMES FOR ALUMINUM. Truant, P. T.; Carbotte, J. P. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 52: No. 7, 618-623(1 Apr 1974).

The electron–phonon scattering times in pure aluminum vary with position on the Fermi surface. There are several sources of this anisotropy. Perhaps the most obvious, but not necessarily the most important, is the distortions of the Fermi surface from a sphere. Another results from the anisotropy in the electron–phonon interaction and in the phonon spectrum. The effect on the electron–phonon scattering times of this latter source of anisotropy is calculated. Large variations over the Fermi surface are found. As the temperature is increased the anisotropy reduces but it is still significant even above 100 K. (auth)

17012 PLASMON SATELLITES IN AUGER SPECTRA. McMullen, T. (St. Francis Xavier Univ., Antigonish, Nova Scotia); Bergersen, B. Can. J. Phys.; 52: No. 7, 624-638(1 Apr 1974).

A theory of Auger spectra in light metals, in which a nonequilibrium formalism is used to handle the aspects of the problem associated with energy loss of the fast electrons and decay of the excited core hole, is presented. The Auger electrons are assumed to reach the surface a time τ after the initial excitation. This time is determined by the decay characteristics of the initial core hole, the geometry, and the velocity of the Auger electrons. After τ, it is assumed that no interactions occur. Electron gas correlations are approximated by a bulk plasmon model. The initial excitation may be due to either x-ray or electron bombardment, although one concentrates on the former. Plasmon production by the primary ejected electrons and the suddenly created core hole is considered. The formalism is based on a perturbation expansion in the electron–plasmon interaction after extraction of the energy shifts, and this procedure is justified by comparison with a simple soluble model. It is applied to third-row (K; LL) Auger transitions. The plasmon gain satellite is compared to the main line, and the entire spectrum is computed in detail for the limiting case of a long lived core hole. (auth)

17013 PEAK ELECTRON EMISSION FROM A TUNGSTEN TARGET AT VARIOUS OPERATING LASER REGIMES. Arifov, U. A.; Kazanskii, V. V.; Lugovskoi, V. B.; Makarenko, V. A. (Inst. of Electronics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 42-45(1974). (In Russian).

The average emission current from a tungsten target was found to depend on the laser power density raised to the fourth power (n = 4). A comparison of correlation coefficients that was carried out shows that a process with signs of a multiquantum photoeffect could be involved. (SJR)

17014 $^2S_{\frac{1}{2}} \rightarrow {}^2D_{\frac{1}{2}}$ DOUBLE-QUANTUM TRANSITION IN H, n = 3. Kramer, P. B.; Lundeen, S. R.; Clark, B. O.; Pipkin, F. M. (Harvard Univ., Cambridge, MA). Phys. Rev. Lett.; 32: No. 12, 635-637(25 Mar 1974).

Rf techniques and a fast hydrogen beam were used to observe in zero magnetic field the two-quantum transition $^2S_{\frac{1}{2}} \rightarrow {}^2D_{\frac{1}{2}}$ in the n = 3 state of atomic hydrogen. The possibility of using this and related transitions for a high precision measurement of the fine-structure constant is discussed. (auth)

17015 FORCE-NEUTRAL BEAMS AND LIMITING CURRENTS. Olson, C. L.; Poukey, J. W. (Sandia Labs., Albuquerque, NM). Phys. Rev., A; 9: No. 6, 2631-2634(Jun 1974).

For intense relativistic electron-beam propagation into low pressure neutral gas in a metallic drift tube, it is shown for typical experimental parameters that the beam leaves the anode only when it is almost space-charge neutral, and that a fully propagating beam occurs only if it is completely space-charge neutral. Ion ionization effects are shown to play a crucial role in the charge-neutralization process, and a new interpretation of existing experimental data is given. (auth)

17016 AUTOMODULATION OF AN INTENSE RELATIVISTIC ELECTRON BEAM. Friedman, M. (Naval Research Lab., Washington, DC). Phys. Rev. Lett.; 32: No. 3, 92-94(21 Jan 1974).

A novel method of automodulating an intense relativistic electron beam was demonstrated. The modulation is accomplished by passing the electron beam through a series of cavities that are inserted into a conventional drift tube. Experimental results indicate that the current is modulated at a frequency of 500 MHz at a relative modulation amplitude exceeding 80%. (auth)

17017 CURRENT AMPLIFICATION IN A RELATIVISTIC ELECTRON BEAM. Wachtel, J. M.; Safran, S. (Yeshiva Univ., New York). Phys. Rev. Lett.; 32: No. 3, 95-98(21 Jan 1974).

Measurements of the current transported when an intense, relativistic electron beam penetrates a low pressure gas show that the net current exceeds the primary beam current. As the pressure is increased, a gradual transition to conditions of magnetic neutralization is observed. Computations of the trajectories of secondary electrons in partially neutralized, uniform beams suggest that secondary electron drift may be responsible for the current amplification. (auth)

17018 COAXIAL MARX GENERATOR FOR PRODUCING INTENSE RELATIVISTIC ELECTRON BEAMS. Kubota, Y.; Kawasaki, S.; Miyahara, A.; Saad, H. M. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 13: No. 2, 260-263(Feb 1974).

A 600 kV Marx generator installed in a completely coaxial form is developed. The structure reduces the internal inductance down to about 80 nH and hence makes it possible to produce high intensity relativistic electron beams of several kA when applied to a field emission type electron gun. The system is remarkably compact in size having the full length of 1400 mm and the diameter of 250 mm. The rise time of the output voltage pulse is less than 8 nsec. (auth)

Atomic and Molecular Properties

Refer also to abstract 17069.

17019 (LA-UR-74-766) BETHE–SALPETER EQUATION: NUMERICAL EXPERIENCE WITH A HYDROGENLIKE ATOM. Gammel, J. L.; Menzel, M. T. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 24p. (CONF-740711-1). Dep. NTIS $4.25.

From 4th international conference on atomic physics; Heidelberg, F. R. Germany (22 Jul 1974).

The eigenvalue λ of the Bethe–Salpeter equation, $\lambda\phi = (1/\pi^2)$ GSϕ, with the value of E_b calculated from the Sommerfeld expression, $E_b = (1/4)\ mc^2\ \{1 - [1/\sqrt{1 + (1/137.03802)^2}]\}$, substituted into the propagator S, and only the one-photon-exchange term included in G, is, for the $^1S_0$ state, $\lambda = 133.9963 \pm 0.0003$. The difference between λ and 137.03802 is due to the appearance of a logarithmic term in $E_b = (1/4)\ mc^2\ \alpha^2\ [1 - (4\alpha/\pi)\ \ln\ (2/\alpha) + \ldots]$, which is valid for the Bethe–Salpeter equation, $^1S_0$ state, one photon exchange. The crossed two photon exchange contribution brings λ up to $\lambda = 136.5 \pm (0.1?)$, so that this contribution cancels the logarithmic term, but not exactly. (auth)

17020 (NRL-7599) ATOMIC AND IONIC EMISSION LINES BELOW 2000 ANGSTROMS. Hydrogen Through Krypton. Kelly, R. L.; Palumbo, L. J. (Naval Research Lab., Washington, D. C. (USA)). 16 May 1973.

A critical tabulation of observed spectral lines below 2000 Angstroms was prepared from the published literature up to May 1972. The first 36 elements, from hydrogen (including deuterium) through krypton are included. The tabulation is divided into two main sections: the emission lines by spectrum, and a finding list. The entries for each element give the ionization species, ground state term, and ionization potential, as well as the best values of vacuum wavelength, intensity, and classification. A list of the pertinent references is appended. (auth)

17021 PART I. THEORETICAL TRANSITION PROBABILITIES FOR THE $2p\pi_u - 1s\sigma_g$ AND $2p\pi_u - 3d\sigma_g$ TRANSITION IN H_2^+. Part II. Possible H_2^+ Ultraviolet Emission Spectrum From Jupiter. Wu, F. M. Albuquerque, NM; Univ. of New Mexico (1973). 224p. University Microfilms Order No. 74-10,354.

Thesis (Ph. D.).

The electronic states of $1s\sigma_g$, $3d\sigma_g$ and $2p\pi_u$ of H_2^+ are known to be bound. The dipole transitions from $2p\pi_u$ to $1s\sigma_g$ and $3d\sigma_g$ are allowed. Yet no band spectra corresponding to these transitions were observed and confirmed. Vibrational–rotational wave functions R_{vj} are combined with the electronic transition moments M_e to determine numerically band strengths and other related quantities for the $2p\pi_u - 3d\sigma_g$ and $2p\pi_u - 1s\sigma_g$ transitions in the H_2^+ spectrum. The calculations were done by using the Simpson integration formula in double precision on an IBM 360/67 computer. Taking into account the finite integration mesh and errors in the wave functions and the interpolated M_e, the results are expected to be good to at least 10^{-4} in atomic units. Results indicate that intense bands are in the region of $36{,}000 > \lambda > 11{,}000$ Å for $2p\pi_u - 3d\sigma_g$ and between $1250 > \lambda > 1170$ Å for the $2p\pi_u - 1s\sigma_g$ transition. The most intense bands occur around $\lambda = 11{,}348$ Å for $2p\pi_u - 3d\sigma_g$ and $\lambda = 1238$ Å for the $2p\pi_u - 1s\sigma_g$ transitions. Comparison of band strengths for different (j', j'') combinations, show that the rotational quantum number can influence significantly the intensity as well as the location of the spectrum lines. The r-centroid approximation is seriously in error for the $2p\pi_u - 3d\sigma_g$ transition, but is reasonably satisfactory for $2p\pi_u - 1s\sigma_g$. It is noted that r-centroid and the average value of M_e can be negative. A possible ultraviolet (UV) emission spectrum of H_2^+ from Jupiter is predicted. Approximately half of Jupiter's upper atmosphere is composed of hydrogen molecules, H_2. It is shown that the molecular ion H_2^+ will be formed mainly by direct photoionization of these molecules and little by other ionic reactions. The chief destruction reaction between H_2^+ and H_2 to form H_3^+ is very rapid. It is estimated that, in equilibrium, the column density on Jupiter of H_2^+ is about 10^8 ions/cm^2. The distribution among vibrational states in the ground electronic state of H_2^+ is assumed proportional to the Franck-Condon factors. The principal process of populating the $2p\pi$ state is predicted to be photo-excitation. The excitation from other processes, involving electron excitation, thermal excitation, charge exchange between He^+ and H_2, and radiative association of $H^+(2s)$ with H, are shown to be very insignificant. Using calculated f-values and the experimental solar spectrum data, calculations showed that the $1s\sigma_g$ state is mostly excited through the solar hydrogen Ly-α line, to the vibrational level $v' = 2$ of the $2p\pi_u$ state. The column production rate of this particular vibrational level is 1.1 ion cm^{-2} sec^{-1}. The most intense emission then is predicted to be the line ($v' = 2$ $j' = 1$, $v'' = 18$ $j'' = 0$) with wavelength 1236.6 Å. The intensity of this line received by a mirror with radius of 3 inches near the earth is expected to be about 10^{-6} photons/sec. (Diss. Abstr. Int., B)

17022 THEORY OF RESONANT MULTIPHOTON PROCESSES. Chang, C. S. (Univ. of Pittsburgh). Phys. Rev., A; 9: No. 5, 1769-1775(May 1974).

The method of high intensity quantum electrodynamics developed earlier is applied to several problems of current experimental interest. The intensity-dependent shifts and widths of atomic levels are calculated and applied to a given transition near resonance. The technique is demonstrated with three examples; the multiphoton ionization of atomic cesium and hydrogen in atomic beams and third-harmonic production in an atomic vapor. It is found that the multiphoton-ionization rate in a relatively weak laser beam (of order 10^8 W/cm^2) is determined by the intensity-dependent level width (6f configuration) as well as the interference of the fine-structure states, and that the rates for hydrogen, in a much more intense beam (of order 10^{12} W/cm^2) are determined by both the intensity-dependent widths and shifts as well as the wave-function renormalization constants. The agreement of these two examples of calculations with the experiments done recently is satisfactory. For third-harmonic production the role of two-photon resonance is emphasized, and the dependence of the generated third-harmonic intensity on the intensity and frequency of the fundamental is discussed. Near resonance, the ratio of third-harmonic intensity to fundamental intensity saturates. (auth)

17023 REGULAR PERTURBATIONS, BRILLOUIN–WIGNER EXPANSION, AND CONTINUED FRACTIONS. Graffi, S. (Instituto Nazionale di Fisica Nucleare, Bologna). J. Math. Phys. (N.Y.); 15: No. 5, 521-523(May 1974).

The least eigenvalue of an operator $H = H_0 + gV$ is considered, where H_0 is a semibounded self-adjoint operator in a Hilbert space and V is symmetric. It is shown that the J-type continued fraction (i.e., the sequence of the [N − 1, N] Padé approximants) to the Brillouin–Wigner perturbation expansion converges to the eigenvalue, provided V is a regular perturbation of H_0. An application of this result to some quantum mechanical systems, such as the helium atom, is briefly discussed. (auth)

17024 SHORT-RANGE INTERACTION BETWEEN HYDROGEN MOLECULES. McMahan, A. K.; Beck, H.; Krumhansl, J. A. (Cornell Univ., Ithaca, NY). Phys. Rev., A; 9: No. 5, 1852-1864 (May 1974).

Recent calculations of the ground-state energy of a system of four hydrogen atoms are reviewed from the point of view of discerning the short-range interaction potential between two hydrogen molecules. Consistency among the results of these calculations suggests that the potential for intermolecular separations in the region 1 to 2.5 Å can now be specified to about 10% with considerable confidence. Analytic fits to spherical averages of these results are presented. For calculations of properties of high density solid molecular hydrogen, the bare pair potential may thus be regarded as well determined. The role of multicenter terms can then be examined; as for example, recent reported work seems to indicate that pairwise additivity is not altogether valid in practice. (auth)

17025 LIFETIME AND HYPERFINE STRUCTURE MEASUREMENTS OF SOME EXCITED STATES OF THE $4d^9$ 5p CONFIGURATION IN THE Pd I-SPECTRUM WITH THE LEVEL CROSSING TECHNIQUE. Liening, H. (Tuebingen Univ. (F.R. Germany). Physikalisches Inst.). Z. Phys.; 266: No. 4, 287-297(Feb 1974). (In German).

8 figs.; 5 tabs.; 28 refs.

Lifetimes and hfs coupling constants of some excited states of the $4d^9$ 5p configuration of Pd I were determined in a level crossing experiment by observing the field dependence of the polarization of the fluorescence radiation in a magnetic field. From the half-widths of the measured zero field level crossing signals the mean lifetimes of the fine structure states $^3P_1^0$, $^3P_2^0$, $^1P_1^0$, $^3D_1^0$ and $^3D_2^0$ and $^3F_2^0$ were determined. $\Delta m = 2$ crossing signals were detected in the $^3P_1^0$, $^3D_2^0$ and $^3F_3^0$-states of the odd isotope ^{105}Pd. A detailed analysis of the experimental curves yields the hfs coupling constants A and B of these states. A theoretical calculation of the hfs constants is given on the basis of reduced matrix elements. Within the limit of the errors these values agree with the experimental ones. The nuclear electric quadrupole moment de-

duced from the measured B values is $Q(^{105}Pd) = (0.8 \pm 0.3) \times 10^{-24}$ cm^2 (without corrections). (orig./GE)

17026 MEAN VALUES OF POWERS OF THE RADIUS FOR HYDROGENIC ELECTRON ORBITS. Bockasten, K. (Lund Inst. of Tech., Sweden). Phys. Rev., A; 9: No. 3, 1087-1089(Mar 1974).

The general formulas available in the literature for calculating the time average of powers of the orbital radius of the electron in hydrogenic atoms or ions, $\langle r^s \rangle$, are of a degree about twice that of the resulting explicit expressions. General formulas are given which are of the right degree and which are written in a suitable form for direct calculation of explicit formulas for specific values of s. Explicit expressions for $\langle r^s \rangle$ are given for $-8 \leq s \leq 5$. It is shown that formulas for positive and negative powers are connected by the formula $\langle r^{-(p+2)} \rangle = (2Z/na_0)^{2p+1} [(2l-p)!/(2l+p+1)!] \langle r^p \rangle$, where p is any integer or zero. (auth)

17027 EXACT SOLUTION FOR THE LINEAR RESPONSE OF ATOMIC HYDROGEN TO AN EXTERNAL ELECTROMAGNETIC FIELD. Luban, M.; Nudler, B.; Freund, I. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). Phys. Lett., A; 47: No. 6, 447-448(6 May 1974).

An exact closed-form solution is presented for the linear response of atomic hydrogen to an external electric field $E = F_0 \cos \omega t$. This has been obtained by extending the method of integral transformations in order to solve the relevant inhomogeneous differential equation. The availability of such a solution should prove to be of great interest, both for theoreticians, for testing various approximation methods, as well as for experimentalists, since the field-induced charge density is directly measurable by non-linear x-ray optical techniques. (auth)

17028 RADIO-FREQUENCY SPECTRUM OF $^3He^-$ AND $^4He^-$. Mader, D. L.; Novick, R. (Columbia Univ., New York). Phys. Rev. Lett.; 32: No. 5, 185-188(4 Feb 1974).

All independent energy intervals were measured in the metastable $1s2s2p\ ^4P$ state of the helium negative ions $^4He^-$ and $^3He^-$. These results are of sufficient precision to provide a critical test of any proposed wave functions for this state and, when adequate wave functions become available, can be used to test relativistic and radiative corrections in three-electron atomic systems. (auth)

17029 NONADDITIVE INTERACTION IN MOLECULAR HYDROGEN AT HIGH PRESSURE. Ree, F. H.; Bender, C. F. (Univ. of California, Livermore). Phys. Rev. Lett.; 32: No. 3, 85-88 (21 Jan 1974).

Ab initio quantum-mechanical calculations were carried out for the pair and triplet potential energies of hydrogen molecules in order to check the pairwise additivity assumption in interpreting the shock experiments of van Thiel et al. It is shown that this assumption fails at distances less than 4.5 bohr. An effective pair potential obtained from the present calculations compares favorably with experimentally determined pair potentials at 3.5 bohr or larger. At shorter distances, it shows the presence of higher-order many-body forces. (auth)

17030 CALCULATION OF PHOTOIONIZATION CROSS SECTIONS USING L^2 BASIS SETS. Broad, J. T.; Reinhardt, W. P. (Harvard Univ., Cambridge, MA). J. Chem. Phys.; 60: No. 5, 2182-2183(1 Mar 1974).

It is shown that bound state techniques may be used for the calculation of photoionization cross sections which are proportional to $\mathrm{Im}\alpha(E + iE)$. As an example of the method the approximations to $\alpha(\omega)$ for the hydrogen atom were computed by diagonalizing the Coulomb Hamiltonian in an appropriate complete discrete p-type Laguerre set. (JFP)

17031 LEADING RADIATIVE CORRECTION TO THE MAGNETIC DIPOLE TRANSITION PROBABILITY. Drake, G. W. F. (Univ. of Windsor, Ont.). Phys. Rev., A; 9: No. 6, 2799-2801 (Jun 1974).

It was recently suggested that a radiative correction of relative order $\alpha \ln\alpha$ may contribute to the $1s2s\ ^3S_1$-$1s^2\ ^1S_0$ magnetic dipole transition of the heliumlike ions. The low frequency contributions to the correction are evaluated and shown to vanish. (auth)

17032 K X RAY TRANSITIONS IN ONE- AND TWO-ELECTRON OXYGEN AND FLUORINE PROJECTILES PRODUCED IN HELIUM, NEON, AND ARGON TARGETS. Hopkins, F. (State Univ. of New York, Stony Brook). Phys. Rev., A; 9: No. 6, 2413-2420(Jun 1974).

Hydrogenlike and heliumlike states in oxygen and fluorine projectiles produced in single collisions in various gas targets were studied via K x-ray emission. Data were taken for oxygen beams of charge states +6, +7, and +8 incident on neon and argon and for fluorine beams of charge states 7+, 8+, and 9+ incident on helium and neon. The relative x-ray intensities corrected for detector efficiency were obtained. The production of transitions in hydrogenlike systems following electron capture by fully stripped projectile (bare nuclei) differs somewhat from predictions based on a simple Brinkman–Kramers theory for the capture process and an inclusion of cascade effects. Excitation of the few-electron projectiles and electron exchange between projectile and target is also indicated by the data. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 15011, 17357, and 17384.

17033 (COO-3244-26) NUCLEAR PHYSICS WITH STOPPED KAON BEAMS. Barnes, P. D. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). [nd]. 30p. (CONF-740201-4). Dep. NTIS $4.50.

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974).

A review of kaonic atoms is presented from the point of view of obtaining information concerning nuclear structure. Those transitions connecting states whose wave functions are nonneglectable inside the volume of the nucleus are emphasized, although the absorption process whereby the orbiting kaon suffers a collision with nucleons in the nuclear surface and disappears with the release of some 100 MeV of energy is also discussed. A brief semiclassical description is given first, and then the experimental technique is simply explained. From data on Pb and U it is clear that not only $\Delta n = 1$ transitions are observed. X-ray cascade calculations are compared with observation; an overall renormalization of 40% is required, but the relative agreement is quite good. The description of the kaon–nucleus interaction by means of an optical potential is considered. Available data on yields, widths, and shifts are shown as a function of atomic number; it is found that a local phenomenological potential with the shape of the nuclear density can give a quite reasonable description of the main features of the data. The determination of the potential from first principles and its use (if it is taken as given by the data) to interpret other data related to the kaon–nucleus interaction are discussed. (19 figures) (RWR)

17034 CHEMICAL REACTIONS OF POSITRONIUM ATOMS IN OXIDIZING SOLUTIONS. Bartal, L. J. Blacksburg, VA; Virginia Polytechnic Inst. and State Univ. (1973). 210p. University Microfilms Order No. 74-7076.

Thesis (Ph. D.).

The study of the reactions of elementary species has lately become an important field in chemistry. The aim of this study is twofold. The first is to understand the nature of these species, and the second is to derive a basic understanding of chemical phenomena by resorting to the simplest reactive species. With this in mind experiments were performed with a unique chemical species—the positronium atom (i.e., the bound, hydrogen-like system of a positron and an electron). The basic objective was to assess its redox powers with a number of chemical systems. A variety of "poor" oxidizing agents were first reacted with the positronium atom to derive an understanding of the energetics of positronium reactions. From this came a theory concerning the "hot" atom character of this species. Next, relatively powerful oxidizing agents were employed to study its thermal reaction facet. From this came an understanding of the effects of ligand nature and solvent character in the redox process. The energetics of the reactions are dealt with in terms of the Estrup-Wolfgang theory of "hot" atom reactions. The chemical effects, such as ligand polarization, steric hindrances, solvent association, and diffusion control, are discussed with the aim of determining the mechanistic pathway of the positronium redox reactions. (Diss. Abstr. Int., B)

17035 COMPARISON OF MUONIC-ATOM AND ELECTRONIC X-RAY ISOTOPE SHIFTS IN LEAD. Ford, K. W.; Rinker, G. A. Jr. (Los Alamos Scientific Lab., NM). Phys. Rev., C; 9: No. 6, 2444-2447(Jun 1974).

New measurements by Lee and Boehm of electronic x-ray isotope shifts in lead substantially reduce, but do not eliminate, the discrepancy between electronic x-ray and muonic isotope shifts in this element. For the isotope pairs $^{208-207}$Pb and $^{206-204}$Pb, the conclusion of Lee and Boehm that electronic and muonic data are now consistent is confirmed. For the isotope pair $^{208-206}$Pb, the reported electronic x-ray shift is less by at least 22% (2 standard deviations) than what would be expected on the basis of the muonic data. Internal inconsistencies in the muonic data for this pair of isotopes can be removed by postulating a nuclear resonance that pushes the $2p_{\frac{3}{2}}$ state up by 0.3 keV or the $2p_{\frac{1}{2}}$ state down by 0.3 keV. For the isotope pair $^{208-204}$Pb, the discrepancy between electronic and muonic data is in the same direction as for $^{208-206}$Pb, but it is somewhat smaller and may not be significant. (auth)

Collision Phenomena

Refer also to abstracts 15648, 17010, and 17382.

17036 (COO-2130-104) ATOMIC AND NUCLEAR RESEARCH WITH ACCELERATORS. Interim Progress Report, January 1, 1972–October 1972. Legg, J. C. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Oct 1972. Contract AT(11-1)-2130. 26p. Dep. NTIS $4.50.

The research summarized covers ion collisions and nuclear physics. (JFP)

17037 (INIS-mf-1249, pp 14-28) ABSOLUTE CROSS SECTIONS FOR EXCITATION OF HELIUM BY ELECTRONS (20 TO 2000 eV) AND THE POLARIZATION OF THE EMITTED RADIATION. Chapter 2. van Raan, A. F. J.; de Jongh, J. P.; van Eck, J.; Heideman, H. G. M. (Rijksuniversiteit Utrecht). 1973.

Absolute cross sections for excitation by electrons from the ground state of helium to 4^1S, 5^1S, 6^1S, 3^1P, 4^1D, 5^1D, 6^1D, 4^3S and 3^3P states of helium were determined by observing the resulting light emission. The energy region covered extends from 20 to 2000 eV. Two devices were used, one for electron energies from threshold up to 100 eV and another for higher impact energies. All line intensity measurements were corrected for the polarization of the radiation, the polarizing effect of the monochromator and space-charge effects. In the evaluation of the excitation cross sections cascading effects were taken into account. The energy dependence of the 1^1S-3^1P cross section is in very good agreement with theoretical calculations above about 200 eV. The experimental values for the n^1S and 3^1P levels are in the asymptotic high energy region about 10% larger than the theoretical ones according to the Born approximation. The energy dependence of the n^1S and 3^1P cross sections are in good agreement with the results of Moustafa Moussa et al. The n^1D cross sections are, although 14 to 35% larger than the theoretical values, closer to the Born values than previous experimental results. In a plot of cross section times electron energy against the logarithm of the electron energy the n^1D curves exhibit a maximum. This effect becomes less pronounced for higher principal quantum numbers. The energy dependences of the 4^3S and 3^3P cross sections do not agree with the E_e^{-2} law as predicted by Ochkur. For energies larger than 100 eV a decrease proportional to $E_e^{-2.0}$ has been found for the 4^3S level and to $E_e^{-2.4}$ for the 3^3P level. The polarization results for the 3^1P-2^1S light emission show very good agreement with the Born theory. The energy dependence of the polarization degree of radiation of n^1D-2^1P transitions is over a large energy range (150 to 1000 eV) in agreement with theoretical calculations. (auth)

17038 (RLO-1388-244) PROJECTILE CHARGE-STATE DEPENDENCE OF Ne K-SHELL IONIZATION AND FLUORESCENCE YIELD IN 50-MeV Cl^{n+} + Ne COLLISIONS. Burch, D.; Stolterfoht, N.; Schneider, D.; Wieman, H.; Risley, J. S. (Washington Univ., Seattle (USA). Dept. of Physics). 1974. 11p. Dep. NTIS $4.00.

Ne K x-ray and Auger-electron production cross sections were measured in 50-MeV Cl + Ne collisions at incident charge states of 5+ to 15+. The ionization cross section and mean fluorescence yield were derived from the data. A factor 20 rise in the x-ray cross section over the charge state range studied is primarily due to a factor 7.2 increase in the mean fluorescence yield. The factor 2.8 rise in the ionization cross section can be explained by a decreased screening of the projectile nuclear charge. (auth)

17039 (RLO-1388-245) EFFECT OF PARTICLE IDENTITY ON THE OBSERVED IMPACT PARAMETER DEPENDENCE OF INNER-SHELL IONIZATION IN SYMMETRIC HEAVY-ION COLLISIONS. Burch, D. (Washington Univ., Seattle (USA). Dept. of Physics). 1972. 7p. Dep. NTIS $4.00.

The decrease in K-shell ionization probability at small impact parameters predicted by a molecular promotion model with rotational coupling cannot be unambiguously tested by experiment if the target and projectile are indistinguishable. (auth)

17040 (RLO-1388-254) Pb K-SHELL IONIZATION AT ZERO IMPACT PARAMETER IN HIGH-ENERGY Cl + Pb COLLISIONS. Burch, D.; Ingalls, W. B.; Wieman, H.; Vandenbosch, R. (Washington Univ., Seattle (USA)). 1974. 29p. Dep. NTIS $4.50.

The absolute ionization probability at zero impact parameter was measured in a coincidence experiment at incident Cl ion energies of 50 to 100 MeV. Total K-shell ionization cross sections are also reported over a larger energy range. The data are compared with theoretical predictions based on the assumption of pure Coulomb ionization as formulated in the binary-encounter approximation (BEA), the semi-classical approximation (SCA), and the plane wave Born approximation (PWBA). It is shown that the good agreement of the total cross sections with nonrelativistic calculations using a straight-line, constant velocity projectile trajectory is to a large extent due to a fortuitous cancellation of the inadequacies of this oversimplified model. Recent impact parameter formulations of the BEA model, including corrections for projectile retardation and deflection and an approximate treatment of relativistic effects, qualitatively reproduce the observed energy dependence of the cross sections and ionization probabilities but overestimate the absolute values by about a factor of 3. Approximate, closed-form, SCA results without these corrections also reproduce the energy dependence but underestimate the ionization probability by a factor of 2 to 3. (auth)

17041 (TID-26583) INTERACTION OF RADIATION WITH MATTER. Progress Report, August 1, 1973–July 31, 1974. (New York Univ., N. Y. (USA). Dept. of Physics). 1974. 289p. Dep. NTIS $17.50.

Research on heavy ion physics, the dynamics of deep atom–atom collisions, and the primary processes induced in condensed matter by ionization radiation is summarized. (JFP)

17042 STUDIES OF EXCITED STATES FORMED IN NEON AND ARGON BY IONIZING RADIATION. Thiess, P. E.; Miley, G. H. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 18: 70-71(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17043 ELECTRON-EXCITATION OF SODIUM AND POTASSIUM AT INTERMEDIATE ENERGIES BY THE METHOD OF CLOSE COUPLING. Korff, D. F. Madison, WI: University of Wisconsin (1973). 193p. University Microfilms Order No. 74-28,928.

Thesis (Ph. D.).

The results of various sets of nonexchange close-coupling calculations for low lying excited states of sodium and potassium at intermediate energies (4 to 24 eV) are reported. For sodium as many as eight atomic states (3s, 3p, 3d, 4s, 4p, 4d, 4f, 5p) were included in the close-coupling wave function expansion, while for potassium as many as fifteen atomic states (4s, 4p, 3d, 4d, 4f, 5s, 5p, 5d, 5f, 6p, 6s, 6d, 6f, 7p, 8p) have been included. The reliability of the first Born approximation is assessed by using the close-coupling calculations including various numbers of states in order to examine intermediate-state coupling effects. Comparison with experiment is also made. The states most susceptible to intermediate-state couplings are the ^2D's and the ^2F's, which are weakly coupled to the ground state. Some of the ^2D multi-state close-coupling cross sections are as much as a factor of two greater than the first Born cross sections, while the multi-state ^2F cross sections are as much as four to ten times the first Born values. The experimental results available for some of the ^2D and ^2F states also lie well above the first Born values, but they also show a decrease in cross section with increase in energy that is too slow relative to that predicted by close coupling. (Diss. Abstr. Int., B)

17044 ELECTRON IMPACT EXCITATION OF NITROGEN: ABSOLUTE CROSS SECTIONS FOR THE LYMAN-BIRGE-HOPFIELD SYSTEM AND ELASTIC SCATTERING; AND A HIGH ENERGY RESOLUTION INVESTIGATION OF THE SECOND POSITIVE SYSTEM. Finn, T. G. Baltimore; Johns Hopkins University (1973). 214p. University Microfilms Order No. 74-10,408.

Thesis (Ph. D.).

The electron impact cross section for excitation of the Lyman-Birge-Hopfield bands and for elastic scattering of electrons from nitrogen was measured in the energy region from 13 to 100 eV. Using an electron spectrometer, the differential cross sections for excitation of the $a^1\Pi_g$ and $C^3\Pi_u$ states and for elastic scattering over the angular range from 5 to 90 degrees were measured. The integrated cross sections were placed on an absolute basis by normalizing the $C^3\Pi_u$ cross section to the known emission cross section for the second positive system of nitrogen ($C^3\Pi_u \rightarrow B^3\Pi_g$ transition) and by calibrating the electron spectrometer with respect to other electron scattering results. The $a^1\Pi_g$ ($v' = 0-6$) cross section was found to reach a peak value of 3.8×10^{-17} cm^2 between 15 and 18 eV and fall off to a value of 5.5×10^{-18} cm^2 at 100 eV. The elastic cross section varies from 9.7×10^{-16} cm^2 at 13 eV to a value of 4.0×10^{-16} cm^2 at 100 eV. A high energy resolution study of the electron impact emission cross section of the second positive system of nitrogen was made by using the electron spectrometer in conjunction with an optical detection system. Observation of scattering resonances in nitrogen and helium have provided an accurate calibration of the incident energy. The maximum in the cross section for the (0,0) band was found to be at 14.02 eV, the maximum for the (1,0) band occurs at 14.3 eV. Both emission functions contain structure which were not observed by previous investigators. (Diss. Abstr. Int., B)

17045 EXCITATION OF ARGON ATOMS BY ELECTRON IMPACT. Ballou, J. K. Jr. Norman, OK; University of Oklahoma (1973). 93p. University Microfilms Order No. 74-6950.

Thesis (Ph. D.).

Electron excitation functions of some thirty states of the $3p^5ns$, $3p^5np$, and $3p^5nd$ configurations of the argon atom were measured by the optical method. In order to evaluate the level cross sections from the optical excitation cross sections one has experimentally determined the branching ratios by measuring the flux ratios for lines originating on the levels of interest. Since the electron-excited source does not provide sufficient intensity to measure the flux ratios, and since the flux ratios do not depend on the manner in which the level of interest is populated a much more intense radio frequency (100 MHz) argon discharge was used as a source for the flux ratio measurements. This procedure gives more accurate level cross sections than does the conventional approach of using theoretical transition probabilities to form the branching ratios since for an atom as complex as argon the wave functions of the excited states calculated by a semiempirical treatment of the fine structure are not always of sufficient accuracy to give reliable transition probabilities. Analysis of the shape of the excitation functions is facilitated by expressing the wave functions of the excited states of argon in terms of the LS-eigenfunctions, and the special features of the experimental data of excitation functions can be readily explained by generalizing the results of helium. Analogous to the case of neon, one can show theoretically that within a configuration $3p^5nl$, the states with odd values of J + 1 in general have larger excitation cross sections than the ones with even values at incident energies well above the threshold and that in general Q (J = 0) > Q (J = 2), Q(J = 1) > Q(J = 3) for the np states, and Q(J = 1) > Q(J = 3), Q(J = 2) > Q(J = 0,4) for nd. The experimental results of the excitation cross sections are found to be in good agreement with these rules. (Diss. Abstr. Int., B)

17046 VIBRATIONAL EXCITATION IN CO_2 VIA THE 3.8-eV RESONANCE. Boness, M. J. W.; Schulz, G. J. (Yale Univ., New Haven). Phys. Rev., A; 9: No. 5, 1969-1979(May 1974).

The vibrational excitation by electron impact on CO_2 was studied in the energy range 3 to 5 eV by observing scattered electrons at an angle of 90°. Such scattering is dominated by the $2\Pi_u$ shape resonance. The energy-loss spectrum at 3.6 eV consists of about 30 peaks, which is associated with two progressions of vibrational excitation of the CO_2 molecule, namely, the n00 and n10 modes. This assignment is consistent with previously measured angular distributions of the inelastically scattered electrons. The energy dependence of the vibrational cross sections exhibits structure. The peaks and valleys of this structure shift to higher energies as the vibrational quantum number of the final state increases. The experimental observations are qualitatively consistent with an extension of the boomerang model which has been developed by Herzenberg for the compound state in N_2. (auth)

17047 BROADENING OF HYDROGEN FLUORIDE LINES BY H_2, D_2, AND N_2. Meredith, R. E.; Smith, F. G. (Science Applications Co., Ann Arbor, MI). J. Chem. Phys.; 60: No. 9, 3388-3391(1 May 1974).

Foreign gas broadening of the vibration-rotation lines in the first overtone band of hydrogen fluoride have been investigated. Linewidths broadened by N_2, H_2, and D_2 were measured for 15 lines in the band at a resolution of approximately 0.1 cm^{-1}. Comparison of the measured widths with predictions based on the Anderson theory show good agreement only for N_2 broadening of the lower J transitions. Theory overpredicts all H_2 broadened widths and all D_2 broadened widths except those for the R(0), P(1), and P(2) lines for the Anderson treatment of close collisions. Better agreement is found with H_2 broadening if the Van-Kranendonk treatment of close collisions is used. The general conclusion reached is that the theory cannot be used reliably to predict vibration-rotation linewidths which are dominated by forces of shorter range than dipole-dipole. (auth)

17048 INTERLEVEL-EXCITATION PROBABILITY IN HEAVY ION COLLISIONS BY USING RELATIVISTIC MOLECULAR STATES. Riesenfeld, P. W. (Univ., Frankfurt am Main). Lett. Nuovo Cim.; 10: No. 9, 365-368(29 Jun 1974).

A formalism is presented for computing transition probabilities in heavy-ion collisions at high energies which properly takes account of the formation of a transient quasi-molecule during the course of the collision. The method of approach is to treat the motion of the two nuclei classically and the motion of the electrons quantum mechanically by using the two-center Dirac equation. (JFP)

17049 EFFECTIVE CROSS SECTIONS OF INDIUM EXCITATION BY ELECTRON IMPACT. Shimon, L. L.; Nepiipov, E. I. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 627-631(Apr 1974). (In Russian).

Excitation cross-sections for seventeen spectral lines were measured, using the method of intersecting electron and atom beams in the energy range from the excitation threshold to 300 eV. Sharp and diffuse series as well as spectral lines generated by excitation of 5s-electron in an indium atom were measured. Moreover, the excitation cross sections of six most intensive In II lines were measured in the spectral region 2300 to 5000 Å. They were excited in one action of mutual collision of incident electrons with indium atoms. The cross section magnitudes in maximum are $10^{-16}-10^{-18}$ cm^2 for the atom lines and $10^{-17}-10^{-19}$ cm^2 for the ion lines. The largest one has the atom resonance line In λ = 4511 Å that is equal to $Q_{max} = 1.7 \cdot 10^{-16}$ cm^2. But among ion lines the largest magnitude in maximum corresponds to the intercombinative line λ = 2306 Å ($5'S_0-5^3P_1$). The energy behaviour of the radiative cross sections is plotted. The measurements show that, besides excitation of 5p-electron, there also exist excitation and ionization with excitation of $5s^2$-electrons in an indium atom. (auth)

17050 DETERMINATION OF INTERACTION POTENTIAL OF Li^+-He SYSTEM FROM EXPERIMENTAL DIFFERENTIAL CROSS SECTIONS. Bashirov, E. M. (Ulyanovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 7-10(1974). (In Russian).

The interaction potential from experimental differential cross section of dispersion of Li^+ ions on He at energies from 3.64 to 218 eV was reduced by the method of Yakovlev and Bashirov. The numerical values for the potential were determined from a formula that gives the results at distances from 0.5 to 1.5 Å. The results agreed well with those obtained by other methods, but the described method can be used for potential determinations over a wider range of distances. (tr-auth)

17051 SCATTERING OF THREE CHARGED PARTICLES IN ONE DIMENSION. Raju, S. B.; Doolen, G. (Texas A and M Univ., College Station). Phys. Rev., A; 9: No. 5, 1965-1968(May 1974).

A one-dimensional model of three-charged-particle scattering is studied and used as a testing ground for the complex-rotation method for finding resonances. It is shown that the rotation method is very efficient in the accurate location of resonance poles. (auth)

17052 EIKONAL DISTORTED WAVE BORN APPROXIMATION FOR THE EXCITATION OF HYDROGEN BY IMPACT WITH HYDROGEN AND HELIUM IN THE INTERMEDIATE ENERGY RANGE. Shields, R. H. Rolla, MO; University of Missouri (1973). 109p. University Microfilms Order No. 74-4371.

Thesis (Ph. D.).

An eikonal approximation is applied to atom-atom scattering in the intermediate energy range. The theory and the form of the eikonal approximation are reviewed. Also a brief survey of previous theoretical methods for all energy ranges is included. In particular, the differential and total cross sections for the excitation of hydrogen to the 2s and 2p states by impact on hydrogen and helium atoms were calculated using the eikonal distorted wave Born approximation (DWBA) for the incident energy range of 2.25 to 100 keV. The eikonal DWBA differential cross sections are compared to the differential cross sections given by the first Born approximation. The eikonal DWBA results predict a lower cross section for smaller angles and a much slower fall off with larger angles than the first Born approximation. For H-He scattering at 10 keV, the eikonal DWBA differential cross section is compared to experimental data. It was found to agree quite well in shape and slope but differed in magnitude by a factor of four. The eikonal DWBA total cross sections were compared to other theoretical calculations and were found to follow closely to the multistate impact parameter calculations. In the limit of high energies and very small angle scattering, the results for the eikonal DWBA total cross section were shown to reduce to the 2-state distortion approximation. Also for H-He scattering, a comparison of total cross sections is made between the eikonal DWBA results and experimental data. Agreement is found to be poor at the lower energies where the eikonal DWBA results are not expected to be valid and good at the higher energies. (Diss. Abstr. Int., B)

17053 ABSOLUTE DIFFERENTIAL ELASTIC AND INELASTIC CROSS SECTIONS IN 25 TO 140 keV He^+ + He COLLISIONS. Pol, V. Rolla, MO; University of Missouri (1973). 95p. University Microfilms Order No. 74-4364.

Thesis (Ph. D.).

The UMR heavy-ion energy-loss spectrometer was modified to study the angular dependence of elastic and inelastic scattering for 25 to 140 keV He^+ incident on He. The data were obtained as energy-loss spectra at angles from 0 to 7.3×10^{-3} rad (c.m.) with energy-loss resolution of 0.6 to 1.0 eV and angular resolution of 1.2×10^{-3} to 2.4×10^{-3} rad (c.m.). From the spectra average differential cross sections, $\overline{d\sigma}/d\Omega$ (θ), were calculated for elastic scattering, direct excitation of the individual He (n = 2) states, and direct excitation of the He^+ (n = 2) states. By integrating the differential cross sections the total cross section for excitation of the He (n = 2) states was found to be 20×10^{-18} cm^2 at 25 keV (lab) decreasing to 7×10^{-18} cm^2 at 140 keV. At incident lab energies below 100 keV the He ($2\ ^3S$) and He ($2\ ^3P$) states dominate

the He (n = 2) structure at angles close to zero, while the He ($2\,^1P$) state dominates at larger angles. The contribution of the He ($2\,^1S$) state remains below 25% at all angles and energies. The results are compared with previous measurements on this apparatus, with electron capture measurements in the same energy range, and with results of others at lower energies. A comparison is also made with impact parameter calculations and with molecular orbital calculations on the angular dependence of the excitation cross sections. (Diss. Abstr. Int., B)

17054 SIXTH INTERNATIONAL CONFERENCE ON THE PHYSICS OF ELECTRONIC AND ATOMIC COLLISIONS, CAMBRIDGE, MASSACHUSETTS, JULY 28–AUGUST 2, 1969. Abstracts of Papers. Cambridge, MA; Massachusetts Institute of Technology Press (1969). 1109p. (CONF-690702-(Absts.)). $30.00.

Abstracts are presented for the conference covering ionization at high energies by electrons, scattering of heavy particles and intermolecular potentials thermal energy, reactive scattering of ions, rotational–vibrational excitation of molecules by electrons, charge exchange involving protons of hydrogen atoms, photoionization, threshold behavior of electron–atom ionization cross sections, inelastic ion scattering, electron excitation of atoms and ions, ion–molecule charge exchange, and scattering theory. Also discussed are the inelastic scattering of heavy particles above thermal energy, electron excitation of molecules, charge exchange in the production of highly excited states, molecular negative ions, electron attachment and detachment, photodetachment and dissociation, collisional transfer between fine structure levels, ionization by electrons and fast protons, charge exchange at MeV energies, elastic and inelastic total cross sections for electron scattering, positrons and polarized electrons, dissociation, charge exchange, Penning ionization, autoionization, and metastable particle collisions. (JFP)

17055 METHODS OF APPROXIMATE CALCULATION OF ELECTRIC CONDUCTIVITY OF A MIXTURE OF PARTIALLY IONIZED GASES. Nenicka, V. (Electrochemical Inst., Prague). Elektrotech. Obz.; 62: No. 5, 315-319(May 1973). (In Czech).

Approximation methods are discussed for the calculation of electric conductivity as well as the limits of their applicability. The differential cross section for collision of electrons and atoms is defined so as to consider the temperature dependence of the total cross section. It is shown that of practical significance are only several values of the powers of m (−1.5; −1; −0.5; 0; 0.5 and 1) in the expressions for the differential cross section. (Nuclear Sci. Abstr. Czech.)

17056 ONE METHOD FOR DETERMINATION OF THE MAXIMUM OF THE DE-EXCITATION FUNCTION. Korotkov, A. I.; Kazakov, S. M. (Chuvash State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 38-40(1974). (In Russian).

A method of determining the primary maximum of a de-excitation function is analytically based. A formula is obtained for describing the effective cross sections of excitation and ionization of atoms by electron collision. (SJR)

17057 ENERGY TRANSFER IN CLASSICAL COLLINEAR AND PERPENDICULAR CENTRAL COLLISIONS OF A STRUCTURELESS ATOM WITH A MORSE OSCILLATOR. Faubel, M.; Toennies, J. P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F.R. Germany)). Chem. Phys.; 4: No. 1, 36-44(Apr 1974).

The energy transfer in classical collinear (C_∞) and perpendicular (C_{2v}) central collisions of an atom with a Morse oscillator is compared. These collision geometries contribute in classical collisions to experimentally observed inelastic backward scattering of alkali ions from H_2 molecules. For both collision geometries the equations of motion reduce to a set of only two coupled differential equations which can be easily solved numerically. The calculations show that the C_{2v} collisions are more effective than C_∞ collisions at all but the very lowest energies. The calculated $\Delta E/E$ versus E curves for C_{2v} collisions using a Born–Mayer potential for the atom atom-in-molecule interaction could be fitted to the experimental results for $Na^+ - D_2$ yielding reasonable potential values. (auth)

17058 ROTATIONAL EXCITATION OF H_2 AND D_2 BY THERMAL ELECTRONS. Sandvik, T.; Kay, A.; Mentzoni, M. (Oslo Univ. (Norway). Fysisk Institutt). Phys. Lett.; A; 47: No. 6, 461-463(6 May 1974).

The maxwellian average of the time rate of change of the electron energy loss due to rotational excitation is computed. It is shown that a much used approximate expression for this loss rate is in considerable error for $T_2 < 2000°K$ and $T_{gas} = 300°K$. (auth)

17059 EQUIVALENCE OF FADDEEV-TYPE EQUATIONS TO COUPLED-CHANNELS EQUATIONS FOR REACTIVE SCATTERING. Diestler, D. J. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Chemistry); Krueger, H. (Trier-Kaiserslautern Univ., Kaiserslautern (F.R. Germany)). Chem. Phys.; 4: No. 1, 151-156(Apr 1974).

Alternative formal quantum-mechanical descriptions of the scattering of an atom from a diatomic molecule are briefly reviewed. Consideration is then restricted to collisions at energies below the threshold for dissociation. The Moeller wave operator Ω is expressed as a sum of "partial" operators and coupled Faddeev-type equations for the operators are derived. It is shown that Ω, so expressed, operates upon the initial asymptotic state vector $|\phi_i\rangle$ to produce a splitting of the exact scattering state vector $|\psi_i\rangle$ into components which is identical to such a splitting previously intuited for practical calculations. It is concluded that the intuitive splitting is not only correct, but also necessary for a proper description of reactive scattering. (auth)

17060 DISSOCIATION OF HYDROGEN MOLECULES IN COLLISIONS WITH LIGHT ALKALI IONS. II. $Li^+ - H_2$. Schoettler, J.; Toennies, J. P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F.R. Germany)). Chem. Phys.; 4: No. 1, 24-35(Apr 1974).

The dissociation of a ground state H_2 molecule in single collisions with a Li^+ ion has been studied using a time of flight technique over a large range of center of mass scattering angles ($30° \lesssim \nu \lesssim 180°$) and collision energies ($16\ eV \leq E_{cm} \leq 55.5\ eV$). The results have been transformed into the center of mass system to obtain inelastic differential cross sections (contour maps). In contrast to most other scattering experiments on collision induced dissociation, the results at high energies ($E_{cm} > 40$ eV) cannot be explained by a two-step mechanism. Instead dissociation appears to occur in a time comparable to the collision time. The results are consistent with several collision models. Of these the spectator model in which only one of the atoms of the molecule is struck by the incident ion is favored since it is in good agreement with the differential cross sections for backward scattering. (auth)

17061 EFFECT OF PARTICLE IDENTITY ON THE OBSERVED IMPACT PARAMETER DEPENDENCE OF INNER-SHELL IONIZATION IN SYMMETRIC HEAVY-ION COLLISIONS. Burch, D. (Washington Univ., Seattle (USA). Dept. of Physics). Phys. Lett., A; 47: No. 6, 437-438(6 May 1974).

The decrease in K-shell ionization probability at small impact parameters predicted by a molecular promotion model with rotational coupling cannot be unambiguously tested by experiment if the target and projectile are indistinguishable. (auth)

17062 EIKONAL DISTORTED-WAVE CALCULATION FOR THE EXCITATION OF H BY He. Peacher, J. L.; Shields, R. H. (Univ. of Missouri, Rolla). Phys. Rev., A; 9: No. 6, 2371-2377 (Jun 1974).

The eikonal distorted-wave Born approximation developed recently by Chen, Joachain, and Watson is applied to hydrogen excitation by helium impact in the intermediate-energy range. The differential and total cross sections for the excitation of the hydrogen atom to the 2s, $2p_\pm$, or $2p_0$ state by helium impact are presented. These results are compared to experiment and previous calculations. The differential cross section for the excitation of hydrogen to the 2s state compares well with the experimental data of Thomas and Sauers in shape and slope, but has a discrepancy in magnitude. (auth)

17063 DEEXCITATION RATES FOR $He^+(2S)$ IN COLLISION WITH ATOMS AND MOLECULES. Prior, M. H.; Wang, E. C. (Univ. of California, Berkeley). Phys. Rev., A; 9: No. 6, 2383-2392(Jun 1974).

The deexcitation of He^+ ions in the 2S metastable state by collision with eleven different target gases. These include noble gases, symmetric linear molecules, water, and ammonia. From the data are extracts velocity-averaged total deexcitation-rate constants $\langle \sigma v \rangle$ ranging from $1.65(17) \times 10^{-9}$ to $20.9(21) \times 10^{-9}$ $cm^3\ sec^{-1}$ for helium and ammonia, respectively. In all cases the mean energy of the He^+ ions was ≈0.23 eV and the target gases had a 300°K Maxwell–Boltzmann distribution of velocities. The results are consistent with collision-induced Lyman-α emission being a prominent deexcitation mechanism. (auth)

17064 BOUNDS FOR TRANSITION PROBABILITIES IN COLLISION THEORY. Pollak, E.; Levine, R. D. (Hebrew Univ., Jerusalem). Phys. Rev., A; 9: No. 6, 2398-2408(Jun 1974).

Upper and lower bounds for transition probabilities in multichannel collision theory are derived, with numerical applications. The approach provides a general scheme for bounding a unitary matrix which depends on a parameter. Particular choices of the parameter include the radial approach coordinate of the colliding systems, with application to close-coupling expansions (both quantum mechanical and semiclassical); the strength parameter of the potential, with applications to the exponential approximation; the time, with applications to transitions induced by a time-

dependent potential (a case previously treated by Spruch); and, in general, any parameter in the interaction potential. The method is based on two key steps: the derivation of an integral equation for the dependence of the scattering matrix on the parameter, which can then be bounded, and the use of the matrix H (all whose elements are unity) as the initial upper bound for the (absolute value of the) scattering matrix. This initial bound is then improved by iterating the integral equation. Computational examples for rotational excitation in an atom-rotor collision are provided. (auth)

17065 EQUILIBRIUM PROPERTIES OF A TWO-DIMENSIONAL COULOMB GAS. Deutsch, C. (Univ., Paris); Lavaud, M. Phys. Rev., A; 9: No. 6, 2598-2616(Jun 1974).

The canonical partition function of the two-dimensional Coulomb gas interacting through the Coulomb potential $-q_iq_j\ln r_{ij}$ is considered in detail. The equation of state $PV/2N = k_BT - q^2/4$ is shown to be meaningful above the critical temperature $T_c = q^2/2k_B$ through the use of upper and lower bounds (valid for all $T > T_c$) for the canonical partition function Q^* with $\lim Q^* \sim N!(Q_1^+)^N$ as $T \to T_c^+$, Q_1^+ denoting the restriction of Q^* to a pair (±). Below T_c, the equilibrium properties are investigated with the use of the binary approximation proposed by Hauge and Hemmer for charged disks. The resolution of the two-body Schroedinger equation allows us to consider point particles and place on a firm basis preliminary conclusions about the divergent behavior of thermodynamic functions. The pair-correlation function $g_2(r)$ is investigated above T_c for the one-component model within the framework of the Debye approximation, through a potential of average force $w_2(r)$, up to the third order in the plasma parameter q^2/k_BT. The short-range behavior of $w_2(r)$ appears as a renormalizable quantity, while the long-range behavior confirms and extends three-dimensional findings. The $T \to \infty$ limit of the corresponding thermodynamic functions coincides with exact results derived by Mehta for the same model restricted to the unit circumference. Finally, the Debye free energy is shown to fulfill a sufficient condition required by the existence of the thermodynamic limit. (auth)

17066 COMPARISON BETWEEN POSITRON AND ELECTRON EMISSION FROM ALUMINIUM IN THE keV REGION. Braicovich, L.; Fasana, A.; Gambarini, G. (Politecnico, Milan). J. Phys., F (London); 4: No. 5, 792-797(May 1974).

Positrons and electrons were injected by radioactive sources in aluminium absorbers, whose thicknesses were of the order of half range. The emitted particles were counted as a function of their energy, in the interval between 1.5 keV and 3.5 keV. The ratio between positron and electron emission probabilities decreased very rapidly with decreasing energy; in the interval of the measurements a variation of this ratio of at least 100 was measured. Some speculations are given in connection with this experimental result. (auth)

Atomic Theory

Refer also to abstract 17432.

17067 (JEN-264) ORBITALES: A PROGRAM FOR THE CALCULATION OF WAVE FUNCTIONS WITH AN ANALYTICAL CENTRAL POTENTIAL. Yunta Carretero, J.; Rodriguez Mayquez, E. (Junta de Energia Nuclear, Madrid (Spain). Div. de Fisica). 1974. 77p. (In Spanish). Dep. NTIS (US Sales Only) $7.00.

The objective, basis, carrying out in FORTRAN language and use of the program ORBITALES are described. This program calculates atomic wave functions in the case of the analytical central potential $V(r) = (N-1)(K-1/r)e^{-\alpha r^\gamma} - (Z-N+1)/r$ where α, K and γ are typical parameter of each atomic configuration. (auth)

17068 SELECTION OF SELF-CONSISTENT-FIELD ORBITALS. Gilbert, T. L. (Argonne National Lab., IL). J. Chem. Phys.; 60: No. 5, 1789-1791(1 Mar 1974).

A procedure introduced by Davidson for selecting orbital bases on the occupied and virtual Hartree–Fock manifolds is shown to be equivalent to a procedure introduced by Adams. (auth)

17069 EFFECTS OF RETARDATION ON ELECTROMAGNETIC SELF-ENERGY OF ATOMIC STATES. Au, C. K. (Univ. of Illinois, Urbana); Feinberg, G. Phys. Rev., A; 9: No. 5, 1794-1800(May 1974).

The significance of retardation effects in photon emissions and absorptions is emphasized in the calculation of self-energy. It is explicitly demonstrated that inclusion of such effects leads to a finite answer for the shifts of atomic energy levels in a nonrelativistic theory without cutoff. Ambiguities that exist in the mass renormalization in the nonrelativistic approach are pointed out. Such ambiguities vanish from the relativistic theory. Explicit calculation is carried out in the case of hydrogen by utilizing the Coulomb Green's function. The advantage of the present approach in calculating self-energy shift in high-Z hydrogenic ions is suggested. (auth)

17070 VARIATIONAL METHOD FOR EXCITED HARTREE–FOCK ORBITALS. Cheglokov, E. I.; Zelichenko, V. M. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 65-68 (1974). (In Russian).

The variant method for determination of excited Hartree–Fock orbitals is discussed. It is shown that in a model of the state of the system with a "frozen" framework the variant method is equivalent to the potential (V^{N-1}) method. (tr-auth)

17071 OPEN-SHELL GENERALIZED PERTURBATION THEORY. Freed, K. F. (Chicago Univ., Ill. (USA). Dept. of Chemistry). Chem. Phys.; 4: No. 1, 80-95(Apr 1974).

Open shell generalized perturbation theory (GPT) is a systematic scheme for the improvement of a multi-configurational zeroth order wavefunction that can be chosen so the lowest order corresponds to a sum-of-the-pairs-type theory of electron correlation (with or without pair-pair couplings) in the spirit of the theories of Kelly, Sinanoglu, and Nesbet for the single configurational case. Applications are presented to the generalized perturbative solution for individual states and for the simultaneous solution for many nondegenerate states. The (2n+1)-rule of GPT and the interchange theorems of double GPT are illustrated. A brief discussion is included concerning the use of GPT in ab initio evaluations of the true parameters that are customarily only modeled and then fit to experiment in semi-empirical theories of molecular electronic structure. The conceptual value of expressing the results of ab initio calculations in terms of effective hamiltonians is stressed and the relationship between open shell GPT and other theories of electron correlation is also considered. (auth)

17072 SYMMETRIZED-MASTER-EQUATION APPROACH TO SPONTANEOUS EMISSION. Ressayre, E.; Tallet, A. (Univ. Paris-Sud, Orsay, France). Nuovo Cim.; 21B: No. 2, 325-353 (11 Jun 1974).

Spontaneous emission of radiation from extended systems of N atoms (or molecules) is studied by using the master-equation approach. Two internal states are involved for each atom considered as spin ½. In order to treat the master equation, the properties of the irreducible representations of the group of permutations over the spin variables. Assuming that the atoms were equivalently excited, a relevant part of the atomic density operator $\rho(t)$ can be defined. This relevant part of $\rho(t)$ is invariant under any permutation over the spin variables. It obeys a tractable equation of motion that we will call the "symmetrized" master equation or S.M.E. This equation is an interpolation between the master equation for an incoherent decay and the one associated to the co-operative decay in small samples. The preparation of the atomic system is also discussed. The S.M.E. will be valid for atomic systems prepared either by an incoherent excitation process or by intense light pulses which leave the system in highly excited states. Therefore the model will not be used when the atoms have been prepared near the superradiant state. Approximate solutions of S.M.E. are given in the limit of large N. It is found that co-operative effects appear for a larger concentration than that predicted by previous works. This disagreement results from the fact that in the S.M.E. the atomic co-operation number is not a priori constant. For large concentrations, the incoherent process, which still prevails at the beginning of emission, brings about a retardation of co-operative emission. During the fast decay of atoms, the behavior of systems described in S.M.E. is found to be identical to the semi-classical one. Effects of inhomogeneous broadening are also considered. In this case, the incoherent process quenches the co-operative emission except for very large concentrations. Finally, detection aspects of the radiation field are described for detectors set far from the source. (auth)

17073 SEMI-CLASSICAL THEORY OF THE DISPERSION ENERGY OF ATOMS AND MOLECULES. Mahanty, J. (Australian National Univ., Canberra). Nuovo Cim.; 22B: No. 1, 110-120(11 Jul 1974).

A semi-classical formalism is developed to evaluate the change in the energy level of an atomic system, i.e. an atom or a molecule, due to its coupling with the electromagnetic field. It is shown that the formalism is consistent with previously developed semi-classical methods for estimating radiative corrections to atomic energy levels, such as the Lamb shift. In addition, it provides a conceptual basis for a phenomenological approach towards evaluating the dispersion energy of an atomic system, in a manner that takes account of the size of the system. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

17074 ELECTROHYDRODYNAMIC FLOW OF A VISCOUS-PLASTIC MEDIUM IN A PLANE CHANNEL WITH A MOVABLE WALL. Makarov, A. M.; Romanovskii, V. R.; Romanovskii, M. R. Magn. Gidrodin.; No. 1, 150-152(1974). (In Russian).

Consideration is given to the complex shift of a viscous-plastic medium of Shvedov-Bingham in a plane channel with dielectric walls in a homogeneous longitudinal electric field. The velocity distribution of the medium was obtained as a function of the electrical and rheological parameters. (SJR)

17075 STRUCTURE OF EHD SHOCK WAVES IN THREE PHASE MIXTURES CONTAINING TWO TYPES OF CHARGED PARTICLES. EHD Flows Having Discontinuity Surfaces. Gogosov, V. V.; Grigor'eva, O. N.; Naletova, V. A.; Farber, N. L. Magn. Gidrodin.; No. 1, 20-36(1974). (In Russian).

A study is made of one-dimensional EHD flows of a medium consisting of three components: a neutral gas and two types of charged particles each of which possesses its own coefficient of mobility. The medium may be either two types of ions, or charged drops or solid particles. The mobility coefficients are assumed to be given functions which are variable with the flow. An analysis is given of the shock wave structure in these mixtures. Consideration is given to flows, where the current densities of the charged components coincide with the direction of the current, are opposed to it, and also the case, where one of the currents flows along and the other against the flux. From an analysis of the shock wave structure, equations are written out that depict the set of relations at the shock wave front. The form of these equations depends substantially on the values of the mobility coefficients and on the signs of the component current densities. The space charge distribution within the flow structure is found. It is shown that when a surface charge is formed at the shock wave front, the space charge distribution within the wave structure may have one or two maxima tending to infinity as the width of the shock wave front tends to zero. It is pointed out that with movement of mixtures containing N types of ions or charged particles, each of which is characterized by its own coefficient of mobility, the distribution of charge current within the flow structure may have N maxima under definite conditions. The flow structure is investigated under conditions where at a certain cross-section the current density flux may undergo a discontinuity, fall to zero or rise. From an analysis of the shock wave structure, insufficient relations are written out at the wave front, where the corresponding discontinuity in currents takes place within the wave structure. The form of the relations depends on where within the wave structure the discontinuity occurs, and on the values of the velocity and of the mobility coefficient at this point. A study is made of the one-dimensional flow of a mixture of gas and charged particles with a discontinuity surface between the emitter and collector, where the mobility coefficient undergoes a jump at the discontinuity front and where the current moves against the flux under the forces of the electric field. Values are given for the difference in potential between the emitter and collector, and also for the intensity and position of the discontinuity in flux at which a surface charge is formed at the discontinuity front. The distribution of electrodynamic parameters along the flow is found as a function of the intensity of the discontinuity and the magnitude of the applied difference in potentials. (SJR)

17076 TAKING INTO ACCOUNT CURRENT DISTRIBUTION INHOMOGENEITY IN A MHD-GENERATOR CHANNEL. Pobereżhskii, L. P.; Yakhot, A. O. Magn. Gidrodin.; No. 1, 94-98 (1974). (In Russian).

Consideration is given to inhomogeneities associated with the unequal loading of electrode pairs and the three-dimensional character in the distribution of electrical values. A solution is presented to the problem of distribution of electrical potential in a channel of square cross-section with hemispherical electrodes. The results of the calculations, which characterize the longitudinal and transverse inhomogeneities, are presented graphically. (SJR)

17077 ONE-DIMENSIONAL THERMOELECTROHYDRODYNAMIC FLOWS OF WEAKLY CONDUCTING LIQUID. Grosu, F. P.; Bologa, M. K. Magn. Gidrodin.; No. 1, 7-19(1974). (In Russian).

Consideration is given to the conditions of occurrence and development features of one-dimensional thermoelectrohydrodynamic (TEHD) flows, caused by coulombic forces of the electric field, on the assumption that one-dimensional electrohydrodynamic (EHD) flows are a prototype of MHD-flows. It is shown that TEHD-flows are possible in plane and cylindrical channels, filled with a weakly conducting liquid with a linear temperature distribution along the walls. For these models, analytical expressions were found for distribution of velocity, temperature, density of space charge and density of electric convection currents. A strong dependence of TEHD-effect was established as a function of temperature gradient and the gradient in the difference of electric potentials on the channel walls. It is shown that the average density of the convection current can exceed by many orders of magnitude the current density of open conductivity. This feature is of interest from a general physical point of view and also in light of creating electrohydrodynamic energy converters. (SJR)

17078 CONVECTIVE INSTABILITY OF A LIQUID LAYER IN A MAGNETIC FIELD WITH THE FINITE WALL THICKNESS AND THERMAL CONDUCTIVITY BEING TAKEN INTO ACCOUNT. Wu Zui K'uang. Magn. Gidrodin.; No. 1, 83-88(1974). (In Russian).

A study is made on the convective instability of a horizontal layer of an electrically conducting fluid, that was caused by Joule heat evolution on flow of a constant current with the fluid being in a constant transverse magnetic field, with the finite thickness and thermal conductivity of the boundary wall layers being taken into account. The external wall surfaces are assigned constant but different temperatures. The equations of small monotonic perturbations of equilibrium are solved by means of a variant of the method of Bubnov–Galerkin in which approximations are used that contain four basic functions. A range of problem parameter values is found in which the finite thickness and thermal conductivity of the walls have a strong effect on the critical Rayleigh numbers. It is noted that because of Joule heat evolution and conjugate thermal boundary conditions the critical Rayleigh number can be negative. (SJR).

17079 LAMINAR ONE-DIMENSIONAL FLOW OF A FERROSUSPENSION IN AN ALTERNATING MAGNETIC FIELD. Maiorov, M. M.; Tsebers, A. O. Magn. Gidrodin.; No. 1, 78-82(1974). (In Russian).

A study is made on the unsteady, one-dimensional flow of a dilute ferrosuspension in a plane channel with a magnetic field varying according to the relation $H = H_0 \cos \omega t$. The taking into account of internal rotation of particles leads to the appearance of a variable component viscosity $a \cos \omega t$ ($a < 1$). The problem is solved with the use of a Laplace conversion with respect to the variable $\tau = t + (a/\omega) \sin \omega t$. It is shown that at a given pressure drop the intensity of velocity oscillations along the channel cross-section varies nonmonotonically. In this case the position of the maximum in intensity of pulsations with increasing ω is displaced toward the channel walls. On the basis of an analysis of the first and second harmonics of the oscillations in mass flow the role of nonlinear distortions of the inlet signal is estimated. In the case of a given mass flow up to a frequency at which it is still possible to neglect the propagation of elastic perturbations, the pressure oscillations reproduce the oscillations in effective viscosity without distortion. (SJR)

17080 EFFECT OF A LONGITUDINAL MAGNETIC FIELD ON THE TEMPERATURE FIELD, HEAT EXCHANGE, AND TURBULENT HEAT TRANSFER COEFFICIENT DURING MERCURY FLOW ALONG A CYLINDRICAL PIPE. Genin, L. G.; Manchkha, S. P.; Sviridov, V. G. Magn. Gidrodin.; No. 1, 70-77(1974). (In Russian).

An experimental study is presented on the temperature fields during flow of mercury in a circular vertical tube in a longitudinal magnetic field. The determining parameters were changed within the following limits: $Re = 7$ to 50×10^3 which corresponds to the region of the strongest effect of the longitudinal magnetic field on the heat exchange $q = 0.5$ to 3×10^4 watts/m^2, H_a (Hartmann number) = 0 to 550. Heat transfer coefficients and coefficients for turbulent heat transfer were calculated from the measured temperature profiles. From the experimental results it is possible to obtain a more accurate estimate of the effect of the longitudinal magnetic field on the heat transfer, and these results show that there is a substantial lowering of the turbulent heat transfer coefficient in a magnetic field. (SJR)

17081 FLOW INSTABILITIES OF A CONDUCTING LIQUID. Aref'ev, V. I. Magn. Gidrodin.; No. 1, 55-63(1974). (In Russian).

Within the framework of two-component hydrodynamics a study is made of instabilities of the plane-parallel flow of a conducting liquid in a MHD-channel in crossed electrical E and magnetic H

fields. In this case attention is turned to the particular role of kinetic effects in the excitations of oscillations, thanks to which the instability criterion is lower than in the single-liquid approximation. Analysis of kinetic instabilities is carried out within the framework of quasilinear theory describing a weakly turbulent flow. The profile of turbulent flow is found with turbulent conductivity and viscosity being taken into account. The results of the theory are in qualitative correspondence with the experimental dependencies which are discussed. (SJR)

17082 STRUCTURE OF THE PERTURBED REGION IN THE CASE OF SELF-SIMULATING BLAST IN A MAGNETIC FIELD. Roikhvargar, Z. B. Magn. Gidrodin.; No. 1, 49-54(1974). (In Russian).

Proof is given for the necessity of occurrence of a slow shock wave during self-stimulating explosion in a magnetic field. Qualitatively the form of the slow and fast shock waves is found at various values of the initial data. It is shown that the cavity cannot be connected to a fast shock wave, and the rate of cavity expansion in the direction of the magnetic field is found in the limiting case of a weak explosion. It is shown that with a strong explosion in a suitably weak field the magnetic pressure on the surface of the cavity is comparable with the gas pressure. (SJR)

17083 MAGNETIC FIELD GENERATION IN A TURBULENT CONDUCTING FLUID. Tseskis, A. L.; Tsinober, A. B. Magn. Gidrodin.; No. 1, 43-48(1974). (In Russian).

It is shown that the rise time of the field satisfies a certain inequality having an obvious physical sense. A theory of magnetic instability is constructed that is analogous to Landau's theory describing hydrodynamic instability. A general equation is derived for generation of a regular magnetic field. (SJR)

17084 TRANSVERSE EDGE EFFECT IN A CYLINDRICAL MHD-CHANNEL WITH A MODULE SIDE WALL. Kovalev, L. K.; Koneev, S. M. A. Magn. Gidrodin.; No. 1, 99-106(1974). (In Russian).

Consideration is given to the transverse edge effect in a cylindrical MHD-channel having continuous electrodes and a side wall consisting of a conducting module separated from the electrodes by nonconducting sections. The transverse external magnetic field B and the conductivity are assumed to be constant in the cross-section of the channel. At a given axially-symmetric velocity profile the problem solution is obtained by a conformal reflection at half the channel onto the upper semiplane with subsequent use of the Keldysh-Sedov formula. The density distributions of current and potential in the channel cross-section are investigated. The integral characteristics of the channel are found as a function of the exposure angle of the electrodes and as a function of the fractions of nonconducting sections in the side wall. (SJR)

17085 SUPERCRITICAL RING MHD COUETTE FLOW IN AN AXIAL MAGNETIC FIELD. Gurfink, M. M. Magn. Gidrodin.; No. 1, 147-148(1974). (In Russian).

From the nonlinear theory of Stuart it is possible to calculate the parameters of eddy Taylor flow after loss of stability on flow between coaxial cylinders. To do this an energy balance equation is used for stationary perturbed flow whose form is taken from linear theory. As a result an equation is obtained with respect to the "amplitude multiplier". This equation contains integrals which are determined by the functional dependence of the amplitudes of the velocity perturbation components as a function of the radius, the Reynolds number, the gap width, the Taylor number and a dimensionless perturbation wavelength. Dissipative and generative energies are represented in the equation. An equation is obtained for a dimensionless rotating momentum. Calculated momentum values compare well with experimental values. It is concluded that in a magnetic field the configuration of the secondary eddy flow is conserved at Taylor numbers significantly exceeding critical values. (SJR)

17086 TAKING INTO ACCOUNT THE CONDUCTING CHANNEL WALLS OF A MHD-MACHINE IN CALCULATING THE LONGITUDINAL EDGE EFFECT. Vol'dek, A. I.; Tolvinskaya, E. V. Magn. Gidrodin.; No. 1, 155-156(1974). (In Russian).

Expressions have been derived from which it is possible to calculate the longitudinal edge effect in a linear induction machine. However the expressions are valid only for machines having a homogeneous secondary medium, that is, a solid working body or a liquid working body with nonconducting channel walls. In machines with a weak transverse edge effect for design purposes it can be assumed that the liquid metal and wall material are homogeneously distributed along the gap. Expressions for the current densities in the liquid metal and in the wall are developed, and by a suitable series of conversions, expressions are obtained for the relative resistances and total power of the MHD-machine with the longitudinal edge effect and wall conduction being taken into account. The calculated and experimental values of the power show satisfactory agreement. (SJR)

17087 EVOLUTION OF SWITCHING-ON AND SWITCHING-OFF MAGNETOHYDRODYNAMIC WAVES. Roikhvarger, Z. B.; Syrovatskii, S. I. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 4, 1338-1342(Apr 1974). (In Russian).

It is shown that in investigations of evolutionary properties of singular inclined waves or rotational discontinuities in magnetic hydrodynamics allowance should be made for dissipative effects. In this case dissipative waves should be taken into account in the system of low amplitude waves moving away from the discontinuity. As a result it is found that there is a single solution of the small perturbation problem for switch-off waves, i.e. such waves are evolutionary. The shock switch-on wave in the linear approximation and the rotational discontinuity are not evolutionary. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 16534, 17356, and 17377.

17088 (ANL-8080) PROCEEDINGS OF THE SYMPOSIUM ON ADVANCED TECHNOLOGY ARISING FROM PARTICLE PHYSICS RESEARCH, MAY 17, 1973. Arnold, R. C.; Thomas, G. H.; Wicklund, B. W. (Eds.). (Argonne National Lab., Ill. (USA)). 1973. Contract W-31-109-eng-38. 203p. (CONF-730541-). Dep. NTIS $7.60.

From symposium on advanced technology arising from particle physics research; Argonne, Illinois, USA (17 May 1973).

The conference included 20 papers, four of which were abstracted previously in NSA. For abstracts of these papers see CONF-730541 in a cumulative report number index. Separate abstracts were prepared for eight papers. Other papers were outside the subject scope of NSA. (JFP)

For abstracts of individual papers see: 15541, 15650, 16068, 16656, 16977, 17091, 17289, and 17434.

17089 (CERN-Trans-74-2) IS IT INDEED IMPOSSIBLE TO FIND QUARKS? Landsberg, L. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov, Inst. Fiziki Vysokikh Ehnergij). Jan 1974. Translation by B. Hodge of IFVE-SEF-73-48. 21p. Dep. NTIS (US Sales Only) $4.25.

The discussion of the search for quarks covers a brief review of the results of quark searches, possible methods of searching for quark production in hadron processes with large momentum transfers, and the search for quarks in deeply inelastic lepton processes with large momentum transfers. (JFP)

17090 (RL-74-27) PROCEEDINGS OF A SEMINAR ON BOOKKEEPING SYSTEMS FOR HIGH ENERGY PHYSICS EXPERIMENTS, RUTHERFORD LABORATORY, JANUARY 25, 1974. Rosner, R. A. (ed.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1974. 34p. (CONF-740127-).

The aims of the discussion were:-to examine the work done on bookkeeping, master list and automatic job submission systems and to exchange ideas; to determine the essential features of such systems; to ascertain whether the basis for a general experiment-independent package exists. Papers were contributed under the following titles: automatic tape handling, a system for the submission of bubble chamber group production jobs, a master list and index system used in the analysis of high energy physics experiments, a bookkeeping system for counter experiments, π 9 software bookkeeping and automatic job submission, and notes on the K13C bookkeeping system. The final section of the document is a summary of the main ideas and points of discussion. It includes a suggestion for the implementation of a general bookkeeping package based on one of the systems described at the seminar. (UK)

Electromagnetic

Refer also to abstracts 16714-16716, 16719-16722, and 17371.

17091 (ANL-8080, pp 16.1-16.10) MUON TELECOMMUNICATIONS. Arnold, R. C. (Argonne National Lab., IL). 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

A muon telegraph was built, and its design and operation is described. The possibilities and advantages of using this means of communication are discussed. (JFP)

17092 (ANL/HEP-7430) TWO-BODY NEUTRINO REACTIONS: FORM FACTORS. Schreiner, P. A. (Argonne National Lab., Ill. (USA)). 1974. 40p. (CONF-740455-1). Dep. NTIS $5.00.

From international conference on Neutrino physics and astrophysics; Dowingtown, Pennsylvania, USA (25 Apr 1974).

A review of experiments to measure hadronic form factors in two-body and quasi-two-body neutrino reactions is presented. (auth)

17093 (CONF-730804-P3, pp 2013-2018) ASTROPHYSICAL UPPER BOUNDS ON NEUTRINO-NUCLEON CROSS SECTION AT ENERGY $E \geq 3.10^{17}$ EV. Berezinskii, V. S.; Smirnov, A. Yu. (Inst. for Nuclear Research, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The possibility of experiments with cosmic neutrinos of energy $E_\nu \geq 3.10^{17}$ eV is discussed. The upper bound on neutrino-nucleon cross section $\sigma < 9{,}3.10^{-30}$ cm^2 is obtained from zenith angular distribution of extensive air showers under some particular astrophysical assumptions. (auth)

17094 (CONF-730804-P3, pp 2027-2031) QUESTION ON THE TOTAL NEUTRINO-NUCLEON INTERACTION CROSS SECTION. Volkova, L. V.; Zatsepin, G. T. (Inst. for Nuclear Research, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

From the analysis of neutrino experiments in cosmic rays at the assumption of linear increase of total neutrino-nucleon interaction cross-section $G_{\nu N}$ with neutrino energy E_ν until energies which give essential contribution into neutrino-induced muon flux it follows: $G_{\nu N} = (0.55 \pm 0.15) \cdot 10^{-38} E_\nu$ cm^2/ nucleon. (auth)

17095 (CONF-730804-P3, pp 2057-2062) NUCLEAR INTERACTION OF MUONS WITH ENERGY ABOVE 0.5 TeV. Erlykin, A. D.; Kulichenko, A. K. (Lebedev Physical Inst., Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Neutron production in cascades produced by high energy muons in lead was studied. It was shown that the fraction of nuclear cascades in the region above 0,3 TeV didn't exceed several percents. The value $\delta_{\gamma n} A^2$ for lead obtained in this experiment was found to be 6.78 ± 5.06 mb. (auth)

17096 (CONF-730804-P3, pp 2118-2123) SEARCH FOR HEAVY LEPTONS IN COSMIC RADIATION AT A DEPTH OF 7.6 hg cm^{-2} UNDERGROUND. Bhat, P. N.; Ramana Murthy, P. V. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An experiment to search for long-lived heavy leptons in cosmic radiation has been in operation at Kolar Gold Fields at a depth of 7.6 hg cm^{-2} (1 hg cm^{-2} = 100 g. cm^{-2} of matter) from the surface. The experiment is sensitive to heavy charged leptons with masses greater than that of a kaon, velocities < 0.75 C and lifetimes $\gtrsim 1$ μs. The method consists of selecting charged particles with velocities < 0.75 C and observing their ranges in iron. Three liquid scintillators and one water Čerenkov Counter are used for particle selection and arrays of neon flash tubes interspersed with iron absorbers for range observation. In the data analyzed so far, we have seen no examples of heavy leptons and an upper limit of 6×10^{-7} (90% confidence limit) is set to the ratio of the flux of slow heavy leptons to that of all muons. (auth)

17097 (NP-20053) MULTICHARGED PARTICLE EMISSION IN THE DISINTEGRATION OF CARBON INDUCED BY HIGH-ENERGY ELECTRONS. Baroni, G.; Di Liberto, S.; Petrera, S.; Romano, G. (Instituto Nazionale di Fisica Nucleare, Rome (Italy)). 5 Apr 1974. 23p. Dep. NTIS (US Sales Only) $4.25.

The disintegration of carbon nuclei by 800- and 1000-MeV electrons is studied using plastic detectors. Angular and energy distributions of the emitted Li, Be and B isotopes are presented. In the absence of a clear theoretical model the consistency of the results with an isotropic emission by a moving excited nucleus is analyzed. (auth)

17098 STUDY OF HIGH-ENERGY PHOTOPRODUCTION WITH POSITRON-ANNIHILATION RADIATION. III. The Reactions $\gamma p \to p2\pi^+2\pi^-\pi^0$ AND $\gamma p \to n3\pi^+2\pi^-$. Alexander, G. (Tel-Aviv Univ., Ramat Aviv, Israel); Benary, O.; Dagan, S. Phys. Rev., D; 9: No. 3, 644-648(1 Feb 1974).

The reactions $\gamma p \to p2\pi^+2\pi^-\pi^0$ and $\gamma p \to n3\pi^+2\pi^-$ were studied in three exposures of the SLAC 40-inch hydrogen bubble chamber to a positron-annihilation radiation of energies 4.3, 5.25, and 7.5 GeV. Cross sections for $\Delta^{++}(1236)$, ω, η, and ρ production are given. The associated production $\gamma p \to \Delta^{++}\omega^0\pi^-$ is discussed in terms of a double-Regge exchange model and compared with the reaction $\gamma p \to \Delta^{++}\rho\pi^-$. (auth)

17099 HADRON CONSTITUENTS AND e^+e^- COLLIDING-BEAM EXPERIMENTS. Sanda, A. I. (Stanford Linear Accelerator Center, CA). Phys. Rev., D; 9: No. 3, 780-785(1 Feb 1974).

In order to test the idea that hadrons are made out of some

fundamental constituents, it is most important to state precisely, in a general way, what is meant by the hadronic constituents. The constituents are called partons and a set of basic assumptions are stated. They are weaker than any of the assumptions previously used in connection with the model. With these assumptions it is shown that if $R \equiv \sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to \mu^+\mu^-)$ increases faster than or equal to ln (Q/M) at large Q, then the multiplicity of hadrons in $e^+e^- \to$ hadrons must increase at least as fast as (Q/M)/ln (Q/M). Q is the center-of-mass energy of the colliding beam. The increase in R with Q, itself, does not violate the basic concept of the parton model. If the above relations between the increase in the cross section and the multiplicity are contradicted by experiments at large Q, however, the parton model requires a major overhaul. (auth)

17100 TRIDENTS PRODUCED BY 1 TO 4-GeV POSITRONS. Lim, Y. K. (Univ. of Singapore); Fukui, K.; Young, P. S. Phys. Rev., D; 9: No. 3, 575-580(1 Feb 1974).

The mean free paths for trident production in nuclear emulsions by positrons of mean energies 0.84, 1.71, and 3.42 GeV were determined to be 103 ± 25, 73 ± 16, and 44 ± 9 cm, respectively. Two methods of background corrections were used. The values are found to be consistent with the theoretical total cross sections predicted by quantum electrodynamics. (auth)

17101 ELECTRON-PION COINCIDENCE MEASUREMENTS IN DEEP INELASTIC ELECTROPRODUCTION. Rohlfs, R. C. Ithaca, NY; Cornell University (1973). 178p. University Microfilms Order No. 74-10,899.

Thesis (Ph. D.).

Deep inelastic inclusive π^+ coincidence electroproduction from a 1.27 cm liquid hydrogen target was measured at incident beam energies of 8, 10, and 11.7 GeV at the Wilson Electron Synchrotron at Cornell University. Electron kinematics covered the range of q^2 (invariant mass squared of the virtual photon) from −0.6 to −2.1 $(GeV/c)^2$ and W^2 (invariant mass squared of the virtual photon-target proton system) from 3.1 to 16.1 GeV^2. Final state particles were detected with scintillation counters and momentum analyzed with magnetic spectrometers using magnetostrictive spark chambers. Pion distributions were analyzed in the virtual photon-target proton c.m. frame where X is defined as the ratio of the pion's longitudinal momentum to its kinematic limit and P_t is the pion's transverse momentum. Results are reported for $-0.25 < X < +0.05$ (in bins centered at −0.2, −0.1, and 0.0) and for P_t^2 up to 0.3 $(GeV/c)^2$. Invariant cross sections $E_\pi(d^3\sigma_\pi/d\vec{P}^3$ are found and fit to the form $Ae^{-BP_t^2}$. The results of the fit are used to calculate

$$F(X) = \int_{P_t^2} E\,\frac{d^3\sigma}{d\vec{P}^3}\,dP_t^2/\sigma_{tot}^{inel}$$

and

$$f(X,O) \equiv \frac{E\,\frac{d^3\sigma}{d\vec{P}^3}\Big|_{P_t^2=0}}{\sigma_{tot}^{inel}} = \frac{A}{\sigma_{tot}^{inel}}$$

where σ_{tot}^{inel} is the total inelastic single arm cross section. No significant variations of B, F(X) or f(X,O) are observed as functions of q^2 or W^2. No significant variation of B with X is observed in the range of the data. (Diss. Abstr. Int., B)

Weak

Refer also to abstract 16709.

17102 (COO-2114-14 and App.) ELEMENTARY PARTICLE AND HIGH-ENERGY PHENOMENA. Progress Report, May 1973–April 1974. Nauenberg, U.; Bartlett, D. (Colorado Univ., Boulder (USA). Dept. of Physics and Astrophysics). 1 May 1974. Contract AT(11-1)-2114. 39p. Dep. NTIS $5.00.

Experimental research is summarized on neutral kaon decay and on a search for tachyon monopoles in the cosmic radiation. A list of publications is included. (JFP)

17103 (COO-3539-4) EXPERIMENTAL INVESTIGATION OF PION DECAYS AT THE CLINTON P. ANDERSON MESON PHYSICS FACILITY. Auerbach, L. B.; Highland, V.; McFarlane, W. K.; Pratt, J. C. (Temple Univ., Philadelphia, Pa. (USA). Dept. of Physics). 1974. Contract AT(11-1)-3539. 4p. Dep. NTIS $4.00.

The testing and calibration of the experimental equipment is briefly described for the experiment on pion beta decay. (JFP)

17104 WIDE-GAP SPARK-CHAMBER STUDY OF $K_L^0 \to \pi + e + \nu$ DECAY. Wang, L. (Univ. of Maryland, College Park); Smith, R. C.; Whatley, M. C.; Zorn, G. T.; Hornbostel, J. Phys. Rev., D; 9: No. 3, 540-555(1 Feb 1974).

A wide-gap spark chamber operated in a magnetic field was used to measure the energy dependence of the form factor $f_+(q^2)$ in $K_L^0 \to \pi + e + \nu$ decay. Decays of K_L^0 mesons in vacuum were detected in the −30° neutral beam of the AGS at Brookhaven National Laboratory. K_{e3}^0 decays were identified by electromagnetic showers produced in a lead radiator plate between the two 12-inch gaps of the chamber. The linear parameter λ_+ in the form factor $f_+(q^2)$ was determined to be 0.040 ± 0.012, where the error includes uncertainties in the corrections for systematic effects. A study of these systematic effects and the resulting errors is presented. (auth)

Strong (Baryon-induced)

Refer also to abstracts 16734, 16738, 16789, 16790, 16793, 17372, and 17375.

17105 (CONF-730804-P3, pp 2063-2080) GENERAL CHARACTERISTICS OF INELASTIC PROTON–NUCLEON AND COHERENT INTERACTIONS AT 200 GeV/c. Anzon, Z. V. (Inst. of Kazakh, Alma-Ata, USSR); Antonova, M. G.; Boos, E. G. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Production of charged particles in inelastic proton-nucleon and coherent proton-nucleus interactions at 200 GeV/c was investigated with nuclear emulsions. Cross sections of coherent production of one, three, five, and seven charged particles by protons on nuclei were determined. Analysis of angular characteristics of secondary charged particles showed that showers are anisotropic up to maximum great values of multiplicities, and non-uniform. The non-uniformity of showers may be apparently explained by some tendency to clusterization of particles. (auth)

17106 (CONF-730804-P3, pp 2081-2086) SEARCH FOR QUARKS PRODUCED IN THE INTERACTIONS OF 300 GeV PROTONS. Leipuner, L.; Larsen, R.; Sessoms, A.; Smith, L.; Williams, H. (Brookhaven National Lab., Upton, NY). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A search for quarks with charge (⅓)e and (⅔)e among the secondaries produced in the interaction of 300 GeV protons from the NAL synchrotron is described. Fractionally charged particles were identifiable through their ionization losses in an eight-counter scintillator telescope. No quark signal was found, and it was inferred that the resulting limit on the quark production cross section is 1×10^{-35} cm^2 at 90% significance level. (auth)

17107 (CONF-730804-P3, pp 2087-2089) SEARCH FOR e/3 QUARKS IN COSMIC RAYS WITH THE LEEDS CLOUD CHAMBER. Hazen, W. E. (Univ. of Leeds, Eng.); Hodson, A. L.; Winerstein, D.; Keller, O. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A cloud chamber search is being made for low-ionization tracks occurring in cosmic-ray air showers generated by primary particles of energy $E_0 \geq$ few times 10^{14} eV. The current result is that the flux of e/3 quarks is less than 4×10^{-11} cm^{-2} sec^{-1} sr^{-1} to within a 90% confidence level. (auth)

17108 (CONF-730804-P3, pp 2090-2095) LACK OF FRACTIONALLY CHARGED PARTICLES IN COSMIC RADIATION. Clark, A. F.; Ernst, R. D.; Finn, H. F. (Univ. of California, Livermore). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Artificially produced tracks were used to train a scanner to look with measured efficiencies for very low density tracks in a cloud chamber quark quest. New upper limit fluxes are quoted in particles cm^{-2} sec^{-1} sr^{-1} for track densities which are fractions of normal density: 2×10^{-11} for ⅓ density; 8×10^{-11} for ⅛; 5×10^{-10} for 1/12; 7×10^{-10} for 1/16; 1×10^{-7} for 1/36. (auth)

17109 (CONF-730804-P3, pp 2096-2100) SEARCH FOR ⅔ QUARKS IN REGIONS OF EXTENSIVE AIR SHOWERS OF LOCAL ELECTRON DENSITY >160m^{-2}. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Durham Univ., Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Using a flash tube chamber a search for e/3 quarks was made in regions of EAS of local electron density >160m^{-2}. No events were observed and the upper limit of the flux of e/3 quarks is

found to be $< 5.5\ 10^{-11} cm^{-2} sec^{-1} st^{-1}$ at the 90% confidence level. (auth)

17110 (CONF-730804-P3, pp 2101-2105) UNDERGROUND SEARCH FOR QUARKS. Bristore, L. (CNR, Turin); D'Ettore Piazzoli, B.; Piano, A.; Sitte, K.; Picchi, P.; Visentin, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The analysis of the results of the first 161 hours of operation of a spark chamber telescope located at 40 m.we. underground shows a slight but apparently statistically significant excess of particles which give smaller-than-average pulses in the top detectors of the array, and arrive with delays considerably larger than the mean temporal spread of shower muons. The corresponding flux is of the order $(2 \pm 1) \times 10^{-9}$ cm^2 sr s. But so far no reliable evidence could be established concerning their interaction characteristics. (auth)

17111 (CONF-730804-P3, pp 2106-2111) SEARCH FOR MASSIVE AND/OR FRACTIONALLY CHARGED PARTICLES. Alcock, C. R.; Chisholm, A.; Tyndel, M.; Yock, P. C. M. (Univ. of Auckland, New Zealand). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A cosmic ray telescope was operated for 1900 hours to search for abnormally heavy and/or fractionally charged particles, such as quarks. Speed, ionization and range measurements were recorded for slow ($.2c \lesssim v \lesssim .55c$) particles with mass $\geq m_p$. Analysis of these measurements indicates that two particles may have been detected with mass ~10 GeV and unit charge. (auth)

17112 (CONF-730804-P3, pp 2112-2116) ALTERNATIVE EXPLANATIONS FOR THE OBSERVATIONS OF UNKNOWN HEAVY-MASS PARTICLES IN COSMIC-RAY SHOWERS. Orth, C. D. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Several experiments were conducted in the 1960s in search of unknown heavy-mass strongly interacting particles in cosmic rays using an experimental technique suggested by B. Peters et al. The experiments looked for particles which are delayed $\gtrsim 20$ nanoseconds behind the front of EAS and deposit $\gtrsim 20$ GeV in a "calorimeter." None of the experimental results demand the existence of such particles. All observations can be interpreted as due either to incident nuclei ($Z \geq 2$) or to inaccurate estimates of the systematics associated with energy determination using calorimeters. Monte Carlo calculations are described for several of the calorimeters used, and the ways in which future experiments should avoid the pitfalls of misidentifying nucleons (or alpha particles) as heavy-mass candidates are indicated. (auth)

17113 (CONF-730804-P3, pp 2158-2161) INVESTIGATION OF NUCLEAR INTERACTIONS OF HADRONS AT 5 TO 10 TeV. Apanasenko, N. A.; Dobrotin, A. V.; Emelianov, D. V. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The Tien-Shan installation, consisting of a magnet cloud chamber with an ionization calorimeter, has been radically reconstructed for investigation of hadron-hadron interactions at energies higher than 5 TeV. The electromagnet was dismounted, the cloud chamber was replaced by 3×2 m^2 wide gap spark chamber and the experimental arrangement was completed by an emulsion chamber. The admittance of the installation is equal to 2.2 m^2 ster. The analysis of pictures of spark chamber and data of ionization calorimeter shows, that the part of the total flux, which is detected under conditions of the trigger is $(2 \pm 0.5) \cdot 10^{-2}$ m^{-2}ster^{-1}hour^{-1} for particles with Eo > 2 TeV coming with rather weak accompaniment. (auth)

17114 (CONF-730804-P3, pp 2172-2178) EVIDENCE FOR A NEW MECHANISM OF THE CALORIMETER CASCADE GENERATION ABOVE 200 GeV. Aganina, M. U.; Anoshin, A. I.; Bashindihagyan, G. L.; Belzer, L. I.; Demianov, A. I.; Murzin, V. S.; Saricheva, L. I.; Siniov, N. B. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The behavior of the hadronic cascade in an ionization calorimeter reveals above 200 GeV surprising irregularities which can be considered as a result of a new mechanism - the sort of a binary reaction wherein all the interaction energy is transferred to the two secondary particles, each having 10 times the proton mass, and the number of other unusual properties. (auth)

17115 (CONF-730804-P3, pp 2210-2218) MULTIPLE PRODUCTION OF MESONS IN COSMIC-RAY HIGH ENERGY NUCLEAR INTERACTIONS. Lattes, C. M. G. (Universidade Estaduae de Compinas, Brazil); Mantovani, M. S. M.; Santos, C. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

184 nuclear interactions with $\Sigma E\gamma \geq 5$ TeV are observed with emulsion chamber 15 exposed at Chacaltaya. The measurement shows constancy of the distribution of transverse momentum p_T and of fractional energy $E\gamma/\Sigma E\gamma$. Together with correlation between p_T and normalized emission angle $\theta\gamma\Sigma E\gamma$, it shows existence of a spherical fire-ball of constant mass and temperature. The mass spectrum of a fire-ball has two peaks corresponding to H-quantum and SH-quantum, with their gamma-ray mass 1.3 GeV and ~6 GeV, respectively. (auth)

17116 (CONF-730804-P3, pp 2233-2238) REMARKABLE PHOTOEMULSION EVENT INDICATING A PRODUCTION OF SUPERHEAVY FIREBALL. Dobrotin, N. A.; Tretyakova, M. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An event of the type 3 + 1 + 100p ($E_\gamma \geq 5.10^{12}$ eV) was found during the area scanning of emulsion stack exposed at the balloon flight in 1956. This event was interpreted as a simultaneous generation of a "superheavy" ($n_s = 87$) and a "heavy" ($n_s = 13$) fireballs. The "heavy" fireball (the total mass of it is nearly 10 GeV/c^2) is similar to that found and reported at the Kyoto Conference and the "superheavy" fireball is approximately 10 times heavier. Analysis of experimental data including those of azimuthal angles made it possible to suppose that the "superheavy" fireball decays at first into several "heavy" fireballs which in their turn decay into pions. (auth)

17117 (CONF-730804-P3, pp 2239-2249) DETAILED ANALYSIS OF JET SHOWERS OBSERVED BY EMULSION CHAMBERS WITH PRODUCING LAYER. Kuramata, S. (Nagoya Univ., Japan); Niu, K.; Niwa, K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Detailed analysis of super high energy jet showers observed in emulsion chambers with producing layers exposed to cosmic rays are continued. Relative scattering method for momentum measurement on charged secondary particles is applied to the study of super high energy phenomena. Up to now, no new example of clean X particle was found, but some of dirty candidates. In parallel to the continuation of experiment, reanalysis of old events are also made. (auth)

17118 (CONF-730804-P3, pp 2276-2281) COMPARISON OF EXPERIMENTAL DATA ABOUT HADRON INTERACTIONS AT ENERGY OF 200 GeV WITH MULTIPERIPHERAL THEORY. Lebedev, A. M.; Slavatinsky, S. A. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Partial cross sections of different Feynman diagrams for nucleon interactions at energy of 200 GeV were calculated by means of the Bethe-Salpeter equation. The international solution of the equation was made. The main processes, as calculations have shown, are: the excitation of both nucleons (6,7 mb), the excitation of one or both nucleons and meson cluster (fireball) production (27 mb). The artificial showers for main diagrams were produced by the Monte-Carlo method. The break-down of blocks into individual particles was carried out according to covariant statistical theory. The main characteristics of artificial showers (multiplicity, angular and energetical distributions) were compared with the experimental distributions obtained at 200 GeV. The comparison between theory and experiment has shown that at energy of 200 GeV the multiperipheral theory is in satisfactory agreement with experimental data. (auth)

17119 (CONF-730804-P3, pp 2282-2288) MULTIPLE-PION PRODUCTION ACCORDING TO THE COSMIC RAY AND ISR DATA. Smorodin, Yu. A. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The results of the main cosmic ray experiments bearing on multiple high-energy muon production are summarized in terms of two (fast and slow) cluster model. The inclusive cross sections studied using ISR are calculated. The results are in a quantitative agreement with the bulk of ISR data on pion production. The fast clusters seem to be formed due to fragmentation of the incident particle parton pocket. (auth)

17120 (CONF-730804-P3, pp 2301-2304) EVIDENCE OF A STRONGLY INTERACTING PARTICLE OF MASS 40 GeV. Baruch, J. E. F.; Brooke, G.; Kellermann, E. W. (Univ., Leeds, Eng.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The hadron spectrum obtained by means of a single interaction calorimeter shows a step near $1\text{-}2 \times 10^{12}$eV. It is suggested that this result, in conjunction with results obtained by other groups, can be interpreted as evidence of a new particle of mass 40-70 GeV, a mean life time $> 2 \times 10^{-7}$ s and an interaction length of 1000^{+1400}_{-400} g cm^{-2}. (auth)

17121 (CONF-730804-P4, pp 2639-2644) CRITICAL ANALYSIS OF HIGH-ENERGY INTERACTION MODELS BASED ON AIR SHOWER SIMULATIONS. Grieder, P. K. F. (Univ. of Bern). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 4.

A critical analysis of high energy interaction models was attempted on the basis of air shower simulation calculations. Four different interaction models were built into a very refined air shower simulation program, to determine (a) the model sensitivity of air shower observables, such as energy spectra, particle ratios and others, and (b) to study distinct features due to model differences. The models include a typical single fireball model with isobar component, two different double-fireball models with isobar component and the scaling model. The calculations are carried out for 10^4 to 10^7 GeV proton initiated showers. Typical spectra are shown for the different models and distinct features are discussed. A comparison with experimental data is also included. (auth)

17122 (COO-1545-142) INCLUSIVE PRODUCTION OF Λ^0's USING A POLARIZED PROTON BEAM. Ambats, I.; Hayes, E.; Meyer, W. T.; Ward, C. E. W.; Knasel, T. M.; Swallow, E. C.; Winston, R.; Lesnik, A.; Schwartz, D. M.; Romanowski, T. A. (Argonne National Lab., Ill. (USA); Chicago Univ., Ill. (USA); Ohio State Univ., Columbus (USA)). [nd]. 13p. (CONF-740713-5). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

The spin rotation parameters between the beam proton and the Λ^0 in the reaction $pp \rightarrow \Lambda^0 X^{++}$ are measured using the 6 GeV/c polarized proton beam at the ZGS. Preliminary results indicate that the Λ^0's are unpolarized. Specifically, in terms of parameters for inclusive reactions in the transversity quantization discussed by Doncel and Mendez, the quantities, $P - P' = -0.004 \pm 0.059$, $P + P' = +0.015 \pm 0.076$, $D = -0.07 \pm 0.18$, $R + R' = +0.14 \pm 0.18$, $-A + A' = -0.26 \pm 0.18$ are found on the basis of a part of the data containing 1869 Λ^0 events. (auth)

17123 (COO-3065-77) SMALL ANGLE PROTON SCATTERING FROM 8 TO 400 GeV. Olsen, S. L. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). [nd]. 16p. (CONF-740332-2). Dep. NTIS $4.00.

From 9th Rencontre de Moriond conference; Meribel-les-Allues, France (3 Mar 1974).

Small angle pp scattering was measured at NAL. The slope parameter b(s) and also the ratio of the real to imaginary parts of the forward scattering amplitude were determined at energies up to 400 GeV. The results are consistent with local field theory only if the pp total cross section rises through the ISR energy range. (auth)

17124 (COO-3072-19) MEASUREMENT OF THE ANGULAR DISTRIBUTION OF $n + p \rightarrow d + \gamma$ AS A TEST OF TIME-REVERSAL INVARIANCE. Technical Report No. 6. Goldhagen, P. E. (Princeton Univ., N. J. (USA). Elementary Particles Lab.). Feb 1973. Contract AT(11-1)-3072. 151p. Dep. NTIS $10.75.

Thesis.

The angular distribution of $n + p \rightarrow d + \gamma$ was measured at neutron kinetic energies of 475, 560, 625, and 750 MeV. An intense neutron beam was prepared by allowing deuterons accelerated in the Princeton-Pennsylvania Accelerator to strip in an internal beryllium target. Velocities and angles of the particles were determined using accurate time-of-flight techniques and magnetostrictive read-out wire spark chambers. Results based on 31000 events at nine scattering angles are reported and compared with existing data for the inverse reaction $\gamma + d \rightarrow n + p$. The angular distributions are found to agree, as predicted by time-reversal invariance. (auth)

17125 (COO-3130-TA-305) NUCLEON-ANTINUCLEON PRODUCTION AS THE CAUSE OF σ^{tot}_{pp} RISE AT ISR. Tan, C. I. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). 1974. 12p. (CONF-740332-3). Dep. NTIS $4.00.

From 9th Rencontre de Moriond conference; Meribel-les-Allues, France (3 Mar 1974).

The suggestion that the rise of σ^{tot}_{pp} at ISR is due to the production of nucleon–antinucleon pairs is reviewed. Various techniques for estimating the $N\bar{N}$ cross section are discussed. It is explained why the increase in $N\bar{N}$ production is not cancelled by a corresponding decrease in the rest of the nondiffractive cross section. Phenomenological consequences of the conjecture are provided. The phenomenon of "bare Pomeron renormalization" is clarified. (auth)

17126 (COO-3130-TB-191) RESEARCH PROGRAM IN EXPERIMENTAL HIGH ENERGY PHYSICS. Progress Report, September 1, 1973–August 31, 1974. Shapiro, A. M.; Lanou, R. E. Jr. (Brown Univ., Providence, R. I. (USA)). 1974. Contract AT(11-1)-3130. 52p. Dep. NTIS $5.75.

An experimental program in strong interaction physics is carried out using bubble chamber-hybrid system and counter-spark chamber techniques. The experiments were and are being performed utilizing the accelerators of the National Laboratories at Argonne, Brookhaven, and Batavia. The experiments of the counter-spark chamber group include the following: a study of baryon exchange processes using backward pion charge exchange; a search for high mass boson resonances and the determination of their quantum numbers in antiproton–proton systems; a nucleon–nucleon and meson–nucleon elastic and quasi-elastic scattering experiment at the highest accelerator energies possible; protons, pions and kaons are used as projectiles and protons and neutrons as targets; the role of the pomeron and exchange models generally is being investigated; and a measurement of the antideuteron flux and a search for massive particles made in 300-GeV proton–proton collisions. In 4.1-GeV/c $\pi^+ p$ interactions, the bubble chamber group is studying: π^+ and π^- inclusive distributions; two-particle correlations; two-body and quasi-two-body production mechanisms; and strange-particle production. A multiwire proportional hybrid system has been brought into operation at NAL. With it aspects of 150-GeV/c $\pi^- p$ interactions are being studied: total and partial cross sections; charged-particle multiplicity distributions and their moments; single-particle inclusive distributions and two-particle correlations; leading particle and diffraction phenomena; and production models for high multiplicity events. A list of publications is included. (auth)

17127 MEASUREMENTS OF THE DIFFERENTIAL CROSS SECTION OF THE REACTION $pp \rightarrow d\pi^+$ FROM 3.0 TO 5.0 GeV/c. Anderson, H. L. (Univ. of Chicago); Larson, D. A.; Myrianthopoulos, L. C.; Dubal, L.; Hargrove, C. K.; Hincks, E. P.; McKee, R. J.; Mes, H.; Kessler, D.; Thompson, A. C. Phys. Rev., D; 9: No. 3, 580-596(1 Feb 1974).

A measurement of the complete differential cross section for the reaction $pp \rightarrow d\pi^+$ at 3.00, 3.20, 3.43, 3.65, 3.83, 4.00, 4.20, and 5.05 GeV/c incident proton momentum was made in an attempt to establish the role of the $\Delta(1950)$ in this region. The data show that the previously observed enhancement in the forward cross section between 3 and 4 GeV/c due to this isobar is an effect which damps out quickly as the production angle departs from zero degrees, in contrast with the well known enhancement at 1.35 GeV/c, which is evident at all angles. In particular, the one-pion-exchange model is in poor agreement with the extended set of data. A detailed description is given of a novel proportional-wire-chamber system which facilitated the selection of this rather rare reaction from a very high competing background. (auth)

17128 ANTIPROTON–DEUTERON LOW ENERGY CROSS SECTIONS. Bizzarri, R. (Univ., Rome); Guidoni, P.; Marzano, F.; Castelli, E.; Sessa, M. Nuovo Cim.; 22A: No. 2, 225-250 (21 Jul 1974).

About 45000 interactions of antiprotons of kenetic energy between 57 and 170 MeV were measured in a deuterium bubble chamber. Total and annihilation cross sections were determined at 9 values of the antiproton energy together with the differential cross section $d\sigma/dt$ for scattering events. In spite of the peculiar behavior of the deuteron target at these low energies a reliable measure of the antiproton-neutron annihilation cross section was obtained. (auth)

Strong (Meson-induced)

17129 (COO-3130-TB-187) DIFFERENTIAL CROSS SECTIONS FOR π^-p BACKWARD CHARGE EXCHANGE SCATTERING AT INTERMEDIATE MOMENTUM. DeMarzo, C.; Guerriero, L.; Nicolini, C. (Bari Univ. (Italy)). 1973. Contract AT(11-1)-3130. 34p. (CONF-730943-16). Dep. NTIS $4.75.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

An experiment of good momentum transfer resolution to measure the differential cross section for pi-minus, proton charge exchange scattering in the backward hemisphere at fourteen values of the incident pion momentum from 2.6 to 6.0 GeV/c is described. (JFP)

17130 (LBL-2607) MEASUREMENT OF THE POLARIZATION PARAMETER FOR THE REACTION $\pi^-p \to \pi^0n$ BETWEEN 1.03 AND 1.79 GeV/c. Shannon, S. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). May 1974. Contract W-7405-eng-48. 97p. Dep. NTIS $8.00.

Thesis.

Measurements of the polarization parameter for the reaction $\pi^-p \to \pi^0n$ were made at the five momenta 1.03, 1.245, 1.44, 1.59 and 1.79 GeV/c. A polarized target was used, with polarizations achieved ranging from 48 to 57%. Salient features of the experiment were the use of neutron counters for time-of-flight measurements as well as angular information and the use of optical spark chambers, seven to eight radiation lengths thick, for the detection of the γ rays from the decay of the π^0. The center-of-mass angular range covered by the 20 neutron counters was typically $-.78 < \cos\theta_{c.m.} < .87$. For each momentum there are approximately 10,000 events which fit $\pi^-p \to \pi^0n$ with a confidence level of at least 10%. (auth)

17131 (NAL-CONF-74/55-EXP) INCLUSIVE γ, K^0_S, Λ^0 AND $\bar{\Lambda}^0$ PRODUCTION IN 205 GeV/c π^-p INTERACTIONS. Bogert, D.; Hanft, R.; Huson, F. R. (National Accelerator Lab., Batavia, Ill. (USA)). Jun 1974. 30p. (CONF-740713-2). Dep. NTIS $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Gamma conversions and K^0_S, Λ^0 and $\bar{\Lambda}^0$ decays were analyzed in a 48,000 frame exposure of the FERMILAB 30-in. hydrogen bubble chamber to 205 GeV/c negative pions. The experimental inclusive cross sections are: $\sigma(\gamma) = 170.6 \pm 15.3$ mb, $\sigma(K^0_S) = 3.49 \pm 0.60$ mb, $\sigma(\Lambda^0) = 1.65 \pm 0.33$ mb, and $\sigma(\bar{\Lambda}^0) = 0.57 \pm 0.22$ mb. The average number of π^0's produced per inelastic collision, $\langle n_{\pi^0}\rangle$, rises linearly with n_{ch}, the number of charged particles produced, while $\langle n_{K^0_S}\rangle$, $\langle n_{\Lambda^0}\rangle$, and $n_{\bar{\Lambda}^0}$ are approximately independent of n_{ch}. $F_1(x)$ and $F_2(p_T^2)$ distributions are presented for γ, K^0_S, Λ^0, and $\bar{\Lambda}^0$ production. (auth)

17132 (ORO-3065-31) PROGRESS REPORT, JULY 1, 1973–JUNE 30, 1974. (Duke Univ., Durham, N. C. (USA). Dept. of Physics). 1974. Contract AT(40-1)-3065. 4p. Dep. NTIS $4.00.

Experimental research on pion plus reactions with neon and hydrogen in a bubble chamber is summarized. (JFP)

17133 (RLO-2232-T-1-2) TOTAL PION CROSS SECTION MEASUREMENTS. Annual Progress Report, May 1, 1973–January 1, 1974. Jakobson, M. J.; Jeppesen, R. H. (Montana Univ., Missoula (USA)). 18 Jan 1974. Contract AT(45-1)-2232. 5p. Dep. NTIS $4.00.

Total cross sections are to be measured for π^+ and π^- mesons on a number of nuclei for the pion energy range from 25 to 250 MeV. The initial run is scheduled from mid April to mid May of 1974. The experiment is being performed at the low energy pion (LEP) Channel at LAMPF. The pion channel checkout was completed. A differential isochronous Cherenkov (DISC) counter is to be used to identify the incident pions from 50 to 250 MeV and time of flight counters used for lower energies. Pion attenuation in the target is to be measured by multiwire chambers and scintillation transmission counters. The counters, including the DISC, have all been constructed and checked out. Initial targets include D, ^{4}He, ^{6}Li, ^{7}Li, Be ^{10}B, ^{11}B, C, ^{16}O, ^{18}O, ^{40}Ca and at least one heavy element. The initial run will emphasize lower energies. The goal is for 2% accuracy of the absolute cross sections and somewhat better accuracy for the relative cross sections. (auth)

17134 INCLUSIVE REACTIONS OF $\pi^+ + p \to X + ANYTHING$ (X = π^0,π^+) NEAR 1 GeV. Jain, P. L.; Ahmad, Z.; Girard, B.; Gleason, R.; Pappas, G. (State Univ. of New York, Buffalo). Lett. Nuovo Cim.; 10: No. 4, 144-148(25 May 1974).

It is first pointed out that the lowest pion momentum at which the charged-pion inclusive properties have been studied so far is 3.7 GeV/c, and that the reaction $\pi^+ + p \to \pi^0$ + anything has not been studied heretofore at any energy. A systematic study of experimental results for the reactions $\pi^+ + p \to X$ + anything (X = π^0, π^+) with incident momenta of 1.04, 1.22, 1.39, and 1.76 GeV/c is presented. (LBS)

17135 K^-p INCLUSIVE REACTIONS AT 10 GeV/c. Lo, S. Y. (Univ. of Melbourne, Parkville, Australia); Noble, D. Nuovo Cim.; 22A: No. 1, 137-156(1 Jul 1974).

Data on the one- and two-particle inclusive spectra $K^-p \to (\pi^-, K^0, \pi^-\pi^-, \pi^-K^0)$ + anything are presented for the K^-p reactions at 10 GeV/c. Special attention was given to the study of correlations in the two-particle inclusive spectrum. A new two-dimensional plot in the variables $x_1 \pm x_2$ is proposed, and is argued to be more sensitive to differentiate the present models. For those exclusive channels where data are available, a cluster test is also suggested and applied. Fragmentation-type models are in general favored. (auth)

17136 FRACTION OF STOPPED K^- MESONS WHICH INTERACT WITH FREE HYDROGEN IN PROPANE. Murphy, C. T.; Keyes, G.; Saha, M.; Tanaka, M. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev., D; 9: No. 5, 1248-1255(1 Mar 1974).

In a sample of film containing 13,400 stopped K^- mesons in a liquid-propane bubble chamber, 98 examples of the reaction $K^-p \to \Sigma^-\pi^+$ were found. Using the known branching ratio for this channel, the fraction of K^- which interacts at rest with free protons was found to be (3.2 ± 0.4)%. The result is compared with measurements of the same fraction for π^- mesons and antiprotons. (auth)

17137 MEASUREMENT OF K^0 COHERENT REGENERATION AMPLITUDE IN CU FROM 0.6 TO 1.4 GeV/c. Birnbaum, D. (Carnegie-Mellon Univ., Pittsburgh); Edelstein, R. M.; Fisk, H. E.; Roth, T. S.; Russ, J. S.; Thatcher, R. C.; Hoffman, E. W. Phys. Rev., D; 9: No. 5, 1242-1247(1 Mar 1974).

The magnitude of $|f_{21}(0)|$, the coherent K^0 regeneration amplitude in Cu, was measured for K momenta from 600 to 1400 MeV/c. Results are compared with predictions of an optical model using forward dispersion relation predictions for real parts of kaon–nucleon scattering amplitudes. (auth)

17138 INELASTIC CROSS SECTIONS OF K MESONS IN CARBON AND COPPER AT 2.95 GeV/c. Allen, P.; Mehlhop, W. A. W.; Bowles, P.; Marceilja, O.; Piccioni, O.; Garland, R. W.; Scipione, D.; Marraffino, J. M.; Murty, S. S.; Wheaton, W. (Univ. of California, San Diego, La Jolla). Phys. Rev., D; 9: No. 3, 570-574 (1 Feb 1974).

The reaction cross sections for K^+ and K^- mesons in carbon and copper were measured, at a momentum of 2.95 GeV/c, with an optical spark-chamber apparatus. In order to minimize instrumental biases, every incoming kaon triggered the system, regardless of whether or not an interaction occurred. For (K^+C), (K^-C), (K^+Cu), and (K^-Cu) we obtained, respectively, (163.2 ± 4.2), (198.6 ± 5.3), (633 ± 16), and (762 ± 23), in units of millibarns. (auth)

17139 PARTIAL-WAVE ANALYSIS OF THE LOW-MASS $\pi^+\pi^+\pi^-$ SYSTEM PRODUCED BY INCIDENT π^+ MESONS AT 13 GeV/c. Thompson, G.; Gaidos, J. A.; McIlwain, R. L.; Willmann, R. B. (Purdue Univ., Lafayette, IN). Phys. Rev., D; 9: No. 3, 560-565(1 Feb 1974).

Results are presented at a spin-parity analysis of the $(\pi^+\pi^+\pi^-)$ system formed opposite a proton by incident 13-GeV/c π^+ mesons in a bubble chamber exposure of 750,000 pictures in hydrogen. Relative proportions of the contributing J^P states are given for $(3\pi)^+$ masses between 0.9 and 1.4 GeV/c^2 and their dependence on $t'_{p\to 3\pi}$ is also discussed. Measurement of the phase between interfering production amplitudes gives information about the resonance status of the A_1,A_2 mesons. The method employs the University of Illinois three-body partial-wave analysis program. (auth)

17140 RECOIL-PROTON POLARIZATION IN THE REACTION $\pi^+p \to pX^+$ IN THE A_2 REGION. Abshire, G. W.; Ankenbrandt, C. M.; Brabson, B. B.; Crittenden, R. R.; Heniz, R. M.; Hinotani, K.; Mott, J. E.; Neal, H. A.; Pawlicki, A. J. (Indiana Univ., Bloomington). Phys. Rev., D; 9: No. 3, 603-607(1 Feb 1974).

The results of an experiment are reported which studies the polarization of the recoil proton in the inclusive reaction $\pi^+p \to pX^+$ at 4 GeV/c, where M_X varies from 1200 to 1450 MeV, and t varies from -0.2 to -0.8 (GeV/c)^2. The recoil proton was identified by its time of flight and its momentum, as determined by a wire-chamber magnetic spectrometer. The polarization of the recoil proton normal to the scattering plane was measured with a wire-chamber carbon analyzer. Polarizations are presented

as a function of mass M_X for all t and as a function of t for all masses. The typical error in the polarization is ±0.1. A significant difference is observed in the behavior of the polarization associated with the X^+ and the X^-. Possible implications of this disparity are explored. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 17432.

17141 (COO-1112-245) QUASI-TWO BODY REACTIONS AND PROPERTIES OF RESONANCES. Kane, G. L. (Michigan Univ., Ann Arbor (USA). Dept. of Physics). 1974. 23p. (CONF-740338-1; UM-HE-74-3). Dep. NTIS $4.25.

From symposium on resonance production; Argonne, Illinois, USA (Mar 1974).

The purpose of this analysis is to utilize increased understanding of quasi-two body reactions of recent years to provide a technique for learning about hadron resonant states. A general prescription is given for calculating an "effective" set of amplitudes, density matrices, and cross sections for production of any resonant state for any assumed set of quantum numbers and coupling strengths. Then the assumed properties can be confirmed or falsified by comparison with production data. The method is verified by extracting couplings for some conventional resonances and using them to "predict" other known data. New results are given for the B meson, where the value $F_B^2 \approx .16$ is found from production properties and the width (without analyzing the helicity of the decay ω); for the question of the existence of an A_1 resonance which couples to $\rho\pi$ (it is claimed that $\Gamma(A_1^0 \to \rho\pi \lesssim 10$ MeV)); and remarks are made on various properties of the δ, D and E mesons and for φ and A_2 production. When fully developed, it appears likely that the present method will be a powerful way to obtain evidence about resonance quantum numbers, coupling strengths to various channels, symmetry classifications, and general hadron spectroscopic questions. (auth)

17142 (COO-2114-12) NEW PHYSICAL PHENOMENA AT VERY HIGH ENERGIES. Nauenberg, U. (Colorado Univ., Boulder (USA)). 1973. 8p. Dep. NTIS $4.00.

Phenomena are described which it is believed will be observed when the proposed very high energies are reached. These phenomena include the proton structure, the structure of the weak V−A theory and the unitarity limit, and a search for new particles. (JFP)

17143 (COO-2271-36) DIFFRACTION SCATTERING AND FACTORIZATION THIS SIDE OF ASYMPTOPIA. Finkelstein, J. (Columbia Univ., New York (USA). Dept. of Physics). 1974. 22p. Dep. NTIS $4.25.

Methods are described for calculating amplitudes involving the exchange of an "effective" Pomeron pole, which do not depend on assumptions about the actual asymptotic behavior with energy of these amplitudes. It is shown that an "effective" Pomeron pole should (at least approximately) factorize, and should not decouple from inelastic channels even in the forward direction. (auth)

17144 (COO-3069-197) ECLECTIC VIEW OF THE POMERON. DeTar, C. (Massachusetts Inst. of Tech., Cambridge (USA)). 1973. 11p. (CONF-730976-4; CONF-730943-15). Dep. NTIS $4.00.

From fourth international symposium on multiparticle hadrodynamics; Pavia, Italy (Sep 1973).

A perturbation description of the pomeron is given. Elastic p + p interactions are considered. (JFP)

17145 (COO-3130-TA-304) LARGE MOMENTUM TRANSFER REACTIONS, WITHOUT PARTONS. Fried, H. M. (Brown Univ., Providence, R. I. (USA)). 1974. 4p. (CONF-740713-8). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Three recent experiments involving large 4-momentum transfer are compared to predictions of the hadronic bremsstrahlung model, without partons. (auth)

17146 (COO-3130-TA-309) PROGRESS REPORT FOR A RESEARCH PROGRAM IN THEORETICAL HIGH-ENERGY PHYSICS. Feldman, D. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). 1 Jun 1974. Contract AT(11-1)-3130. 10p. Dep. NTIS $4.00.

Last year's research program dealt with a variety of topics including the application and generalization of the eikonal model (diffractive particle production, Blankenbecler's theorem, multiplicity distributions, bremsstrahlung production); high energy multiparticle phenomena (perturbative treatment of diffraction dissociation, antibaryon production and the rising pp total cross section, rising inclusive plateau); solutions of Reggeon unitarity from the S-matrix approach; dynamical aspect of diffractive production; dual resonance models (low energy partial-wave parameters); implications of neutral currents; dynamics of permanently bound quarks (perturbative expansion, corrections to the mass spectrum); model theories with composite particles; broken gauge theories of the weak and electromagnetic interactions; topics in general relativity; as well as other studies involving the strong, electromagnetic, and weak interactions of elementary particles. A list of publications is included. (auth)

17147 (JINR-P2-7908) S-MATRIX APPROACH TO THE MULTIPLE HADRON PRODUCTION. Dushutin, N. K.; Mal'tsev, V. M.; Sinegovskii, S. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The multiple hadron production was considered from the point of view of quantum field theory. Recurrent correlations are obtained for many-particle amplitudes. The one- and two-particle production is discussed in detail. In the latter case, independent of kinematics, negative values of the second correlation parameter are possible. (auth)

17148 (RLO-2041-108) STATISTICAL DESCRIPTION OF HADRON CONSTITUENTS AS A BASIS FOR THE FLUID MODEL OF HIGH-ENERGY COLLISIONS. Hwa, R. C. (Oregon Univ., Eugene (USA)). 5 Feb 1974. Contract AT(45-1)-2230. 28p. Dep. NTIS $4.50.

The pionization process in high energy collisions is considered in a constituent-fluid model. The fluid picture describes the macroscopic behavior of the hadronic matter under expansion before the formation of physical pions. The constituent picture provides the microscopic basis for the fluid description. Assuming that the hadronic matter is a highly degenerate fermion system, the density and temperature variations during the expansion phase are derived. The single-particle inclusive distribution is shown to be scale invariant and constant in rapidity. (auth)

17149 ARBITRARINESS OF COUPLING CONSTANTS IN ASYMPTOTICALLY FREE THEORIES. Shei, S. S. (Rockefeller Univ., New York). Lett. Nuovo Cim.; 10: No. 10, 405-408 (6 Jul 1974).

It is shown that a previously used equation is in fact an identity and therefore cannot determine the coupling constant. The starting point is the unsubtracted parametric dispersion relation for the four-point vertex function used previously. (JFP)

17150 ASYMPTOTIC BEHAVIOR OF A DUAL TWO-POMERON GRAPH IN THE MISSING-MASS RESONANCE REGION. Ebert, D. (CERN, Geneva); Otto, H. J. Nuovo Cim.; 22A: No. 1, 25-38(1 Jul 1974).

The diffraction dissociation contribution to the inclusive cross-section is studied on the basis of a nonplanar dual two-loop amplitude. The discussion is restricted to the resonance region in missing mass. Pomeron form factors describing coupling to a scalar particle and a resonance of spin j are defined. In the fixed-angle limit a universal exponential behavior dominating the tree B_s-contribution was found. (auth)

17151 CONFORMAL INVARIANT SELF-INTERACTING THEORY. Ven der Merwe, P. duT. (Atomic Energy Board, Pretoria). Lett. Nuovo Cim.; 10: No. 8, 338-340(22 Jun 1974).

As a result of progress in spinor theory a new starting point for constructing a unified self-interacting theory of elementary particles based on conformal invariance is considered. The basic motivation for requiring an underlying conformal invariance derives from the circumstance that the substratum of the theory which describes electrodynamic and neutrino phenomena contained in a unified theory of matter should possess conformal symmetry. (JFP)

17152 MULTIPERIPHERAL MULTIFIREBALL MODEL AND THE INCLUSIVE CROSS SECTION. Chen, C. K. Phys. Rev., D; 9: No. 5, 1476-1485(1 Mar 1974).

A multiperipheral multifireball model with a rising total cross section in a certain energy region is described, and the single-fireball contribution to the single-particle inclusive cross section in the pionization region is studied. The total cross section in this model rises like ln s near the single-fireball threshold, changes to a ln(ln s) behavior until it reaches a maximum at an extremely

high energy, and eventually falls to zero. The magnitude of the possible rise is proportional to the triple-Pomeron coupling. For the single-particle inclusive cross section in the pionization region, the contribution from the term proportional to a Pomeron–Reggeon–Reggeon coupling is shown to be as important as the term proportional to the triple-Pomeron coupling. The contribution from the Pomeron–Reggeon–Reggeon term is estimated by extrapolating the required couplings from the scattering data in the intermediate energy region, and it contributes to a rise of about 16 mb. The rise of the inclusive cross section due to the triple-Pomeron term is about 7 mb when the rise of the total cross section is assumed to be 4 mb at CERN Intersecting Storage Rings energy. The over-all rise of the inclusive cross section in this model is thus about 23 mb. (auth)

17153 COHERENT STATES AND PARTICLE PRODUCTION. Botke, J. C.; Scalapino, D. J.; Sugar, R. L. (Univ. of California, Santa Barbara). Phys. Rev., D; 9: No. 3, 813-823(1 Feb 1974).

Hadron production at high energies is discussed in terms of coherent states. It is suggested that the scattering operator and the pion field density operator take on simple forms in the coherent-state representation. In particular, it was shown that for a wide variety of configurations of the pion field the density operator can be written in diagonal form in the coherent-state representation. When this is possible, one obtains the statistical theory of pion production which was discussed recently. A solvable unitary model is constructed in which the total, elastic, and inclusive cross sections go to constants at high energy, while the exclusive cross sections go to zero like a power of energy. In order to take into account the isotopic spin of the pions, the concept of coherent states is generalized, and states with definite charge and isotopic spin are constructed. (auth)

17154 SCALE-INVARIANT PARTON MODEL. Kogut, J.; Susskind, L. (Tel Aviv Univ., Ramat Aviv, Israel). Phys. Rev., D; 9: No. 3, 697-705(1 Feb 1974).

The assumptions of the parton model are generalized to include the possibility of scale-invariant short-distance behavior. A physical picture is used to motivate the formal equations. Bjorken scaling is violated in a systematic way. The asymptotic properties of νW_2 are computed, and it is shown that its moments are power-behaved functions of Q^2. Arguments are presented for a nonzero value of σ_S/σ_T in the deep inelastic limit. The asymptotic behavior of electromagnetic form factors is found to be $(Q^2)^{-a}$, where the constant a is related to properties of νW_2. (auth)

17155 SETTING THE SCALE FOR PREDICTIONS OF ASYMPTOTIC FREEDOM. Politzer, H. D. (Harvard Univ., Cambridge, MA). Phys. Rev., D; 9: No. 7, 2174-2179(1 Apr 1974).

Asymptotically free theories make explicit predictions for the q^2 dependence of the structure-function moments at present energies. The onset of scaling and the deviation from naive scaling determine the only two free parameters for a particular choice of gauge group and fermion representations. (auth)

17156 ANALYTIC REGULARIZATION AND WARD–TAKAHASHI IDENTITIES IN THE SIGMA-MODEL. Marinaro, M.; Mercaldo, L.; Valasi, G. (Univ., Salerno, Italy). Lett. Nuovo Cim.; 10: No. 9, 361-364(29 Jun 1974).

It is shown how a suitable analytic regularization can be introduced in such a way as to preserve the invariance properties. The sigma model for meson fields is discussed, and it is shown that the Ward–Takahashi identities, which are satisfied by unrenormalized theory, are verified also after regularization. (JFP)

17157 TWO-COMPONENT THEORY OF FERMIONS. Ferents, P. R.; Kostarev, A. I. (Odessa Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 120-122(1974). (In Russian).

This study investigates the well known paradox of Klein in the Volkovyskii representation. It is proved that with passage of a particle from a region with $U(x) = 0$ to a region with $U(x) > mc^2$, transition to an antiparticle state is possible. (SJR)

Electromagnetic

17158 (COO-2271-37) STRUCTURE OF ANOMALOUS LEPTON HADRON INTERACTIONS AND $\pi^0 \to e^-e^+$. Soni, A. (Columbia Univ., New York (USA). Dept. of Physics). 1974. Contract AT(11-1)-2271. 9p. Dep. NTIS $4.00.

The contribution of anomalous lepton–quark (hadron) interaction $\sim \bar{l} O_\mu q X_\mu$ to $\pi^0 \sim e^-e^+$ is very strongly dependent on the form of O. Unless experiments reveal an unexpectedly large branching ratio ($\gg 10^{-8}$) for the process, O must have (V–A) or (S–P) structure. (auth)

17159 (DESY-73/65) CONTRIBUTION OF MULTIPHOTON EXCHANGE IN EP DEEP INELASTIC SCATTERING. Bartels, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 21p. INIS.

14 figs.; 14 refs. With abstract.

An attempt is made, within the light-cone approach, to estimate effects of multiphoton exchange in deep inelastic scattering. For the exchange of n photons in the Bjorken limit, contributions of the form $(\ln^2 Q^2)^{n-1}$ times the one-photon approximation are found. Under the assumption that they are the leading ones in each order, they can be summed up to a power-behaved function of Q^2 which modifies the structure functions $w_i(\nu,Q^2)$ in such a way that in the Bjorken limit they are no longer functions only of ω. A rough numerical estimate indicates that corrections due to multiphoton exchange become important (10% of the one-photon contribution) at about Q^2 approximately 10^4 GeV^2, but are always screened by the larger effect of radiative corrections at the electron vertex. They are, however, directly visible in the e^+p-e^-p differential cross section. (auth)

17160 (JINR-E2-7921) ELECTROMAGNETIC NUCLEON MASS DIFFERENCE, SUM RULES FOR DEEP INELASTIC SCATTERING AND EQUAL TIME COMMUTATORS. Motz, G.; Wieczorek, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 25p. Dep. NTIS (US Sales Only) $4.25.

In one-photon approximation the connection between the finiteness of electromagnetic mass corrections and the light-cone behavior of the product of electromagnetic currents was studied. In the canonical case the complete removal of divergences leads to two sum rules for the scaling functions which are equivalent to vanishing of certain equal-time commutators. Using the technique of the Jost–Lehmann–Dyson representation problems with subtractions are avoided. (auth)

17161 REMARKS ON DUALITY IN DEEP INELASTIC PROCESSES. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 10: No. 4, 129-133(25 May 1974).

It is demonstrated that in a model with infinitely many vector-mesons coupling to the γ^*, the relation for the total annihilation cross section of electron-positrons into hadrons, $\sigma_{e^+e^-}$ (S) = constant, can be obtained aside from a weak s-dependence when the s-dependence in the relation for the decay width of the virtual timelike γ^* into hadrons is shifted to the decay widths of the high-lying vector meson themselves. (LBS)

17162 MULTIHADRON PRODUCTION THROUGH THE PHOTON–PHOTON INTERACTION. Paoluzi, L. (Univ., Rome); Ceradini, F.; Ferrer, M. L.; Santonico, R.; Barbiellini, G.; Orito, S.; Tsuru, T. Lett. Nuovo Cim.; 10: No. 10, 435-439(6 Jul 1974).

The interaction $\gamma\gamma \to$ multihadrons is studied through the process $e^+e^- \to e^+e^-$ multihadrons. Two selected events provide evidence for the studied process. The cross section for the process $e^+e^- \to e^+e^-\eta'$ is calculated, and the η' branching ratios and total decay width are found. (JFP)

17163 COMPTON SCATTERING AND GAUGE INVARIANCE IN DUAL MODELS. Barducci, A. (Univ., Florence); Gomis, J. Lett. Nuovo Cim.; 10: No. 10, 425-429(6 Jul 1974).

A manifestly gauge-invariant expression for the off-shell Compton scattering amplitude is obtained for the fermion and boson cases as a means of studying the gauge invariance properties of the amplitudes in these two cases. It is found that the different behavior in these two cases is related to the presence of spurious states. (JFP)

17164 CONNECTIONS AMONG ONE-PARTICLE INCLUSIVE ELECTROPRODUCTION AND ITS CROSSED PROCESSES OF e^+e^- ANNIHILATION AND PAIR PRODUCTION IN THE DEEP INELASTIC LIMIT. Gatto, R. (Univ., Rome); Vendramin, L. Nuovo Cim.; 22A: No. 1, 109-136(1 Jul 1974).

Threshold relations, such as that between deep inelastic scattering and annihilation, may prove to be more general than scaling. One-particle inclusive deep inelastic electron scattering is studied together with its crossed processes, among them two-particle inclusive e^+e^- annihilation, with the purpose of establishing general connections. In the deep inelastic limit general threshold connections among these processes are derived of a similar kind to those relating inclusive deep inelastic scattering and one-particle inclusive e^+e^- annihilation. Also additional connections, are studied in terms of factorization properties, between deep inelastic scattering and deep-annihilation reactions with one and two detected (initial or final) hadrons. (auth)

17165 INCLUSIVE REACTION $\gamma p \to \pi^- + x^{++}$ MEDIATED BY VECTOR MESON PRODUCTION. Murai, N. (McGill Univ.,

Montreal); Sasaki, T. Progr. Theor. Phys. (Kyoto); 50: No. 2, 610-625(Aug 1973).

The inclusive reaction $\gamma p \to \pi^- + X^{++}$ is investigated under the following assumptions: The pion spectrum results from the ρ meson decay, the vector meson dominance model for the photon is valid and distributions for favored and disfavored fragments are different. A simple ρ distribution scaling at relatively low energies leads quite well to the π^- longitudinal distribution, with the effect of the "elastic" reaction $\gamma p \to \rho^0 p$ excluded. The spectrum has the following features: It increases in the central region and decreases in the proton fragmentation region as energy increases and its slope is gentle in the photon fragmentation region. The π^- distribution integrated over $q_{\perp}^2$ is predicted at E_γ = 18, 30 and 100 GeV. Further, the inclusive reaction $pp \to \pi^- + X^{3+}$ is supplementarily explored in a way consistent with $\gamma p \to \pi^- + X^{++}$ to see that the proton fragmentations have the same distribution irrespective of the impact p and γ. The increase of the distribution in the region $|X_\pi| \lesssim 0.1$ with energy is well reproduced. (auth)

17166 CROSS SECTION ESTIMATES FOR REACTIONS OF WEAK PRODUCTION OF Λ- AND Σ-HYPERONS NEAR THRESHOLD AT γ^- QUANTUM INTERACTION WITH NUCLEONS. Krive, I. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 639-642(Apr 1974). (In Russian).

Threshold cross sections of reactions of solitary production of Λ- and Σ-hyperons in the process $\gamma N \to \Lambda(\Sigma)\pi$ are estimated in terms of the Born approximation. The cross-section values $[(k^*/q^*)(d\sigma/d\Omega)]$ for different considered processes proved to be within the range of $(0.1 \text{ to } 100) \cdot 10^{-44}$ cm^2/ster. Strong sensitivity of the reactions $\gamma p \to \Lambda\pi^+$, $\gamma n \to \Sigma^0\pi^0$ to the constant interference sign in strong and weak vertices is marked. (auth)

17167 PHOTOPRODUCTION OF VECTOR MESONS IN RESONANCE REGION. Lazarenko, L. A. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 632-638(Apr 1974). (In Russian).

The reaction of ρ-meson photoproduction was studied in near-threshold region. Resonances with spin and parity $J^P = \frac{1}{2}^+, \frac{3}{2}^-, \frac{5}{2}^+$ are taken into account. The role of resonances of U-channel and background effects is discussed when describing differential cross-sections of vector mesons photoproduction reactions. (auth)

17168 POLARIZATION PHENOMENA IN PION ELECTROPRODUCTION. Omelaenko, A. S. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 596-602(Apr 1974). (In Russian).

A complete discription of all the measurable characteristics (asymmetry, polarization of recoil nucleon depolarization tensor) in terms of the center-of-mass system amplitudes of the reaction of pion electroproduction by polarized electrons was performed by means of one photon exchange approximation. (auth)

17169 SPHEROIDAL ANALYSIS OF COULOMB SCATTERING. Ming Chiang Li. (Virginia Polytechnic Inst., Blacksburg). J. Math. Phys. (N.Y.); 15: No. 5, 570-575(May 1974).

In studying the spheroidal problem of a charged particle scattered by two charged centers, one must deal with a differential equation. Its solution was complicated. In this paper, we study a very similar differential equation, which appears in the Coulomb problem. The solution for this equation, however, can be put in a simple form. For completeness the spheroidal analysis of the Coulomb scattering amplitude is also discussed. (auth)

17170 QUANTUM CONSERVATION LAWS FOR CHARGED PARTICLE SYSTEMS IN MAGNETIC FIELDS. Petru, Z. K. (Univ., Wroclaw). J. Math. Phys. (N.Y.); 15: No. 5, 640-642(May 1974).

The conservation laws in the exact operator form are derived for the two-component system of interacting charged particles in magnetic and electric fields. These laws represent the equations of motion for the mass-, current-, and energy-density operators, where both the pressure tensor and energy-current operators are calculated exactly. (auth)

17171 DIRECT METHOD FOR CALCULATING THE BOUND FOUR-MOMENTUM OF A CLASSICAL CHARGE. Van Weert, C. G. (Univ., Amsterdam). Phys. Rev., D; 9: No. 2, 339-341 (15 Jan 1974).

It is shown that the bound electromagnetic four-momentum of an arbitrarily moving classical charged particle as defined by Teitelboim can be evaluated in a direct way with the help of Stoke's theorem. The calculation is based on the observation that the nonradiative part of the energy-momentum tensor of a point charge may be written as the divergence of a tensor of a higher rank. By this method a considerable calculational simplification is achieved. (auth)

17172 MEASUREMENT OF CHARGED-HADRON MULTIPLICITIES IN DEEP-INELASTIC ELECTRON-PROTON SCATTERING. Garbincius, P. H. (Cornell Univ., Ithaca, NY); Berkelman, K.; Gibbard, B.; Klinger, J. S.; Wanderer, P.; Sadoff, A. J. Phys. Rev. Lett.; 32: No. 6, 328-330(11 Feb 1974).

Measurements of the charged-hadron multiplicity for electrons scattered by protons at momentum transfers up to $Q^2 = 8$ GeV^2, and for s up to 14 GeV^2 are reported. The multiplicity is consistent with a simple ln s behavior, with little or no Q^2 dependence above $Q^2 = 1.4$ GeV^2. (auth)

17173 WEAK NEUTRAL CURRENT EFFECTS IN e^+e^- ANNIHILATION WITH POLARIZED BEAMS. Kajon, G.; Petronzio, R. (Univ., Rome). Lett. Nuovo Cim.; 10: No. 9, 369-372(29 Jun 1974).

It is pointed out that neutral currents can be positively identified by looking at their interference with the electromagnetic current in one-particle inclusive e^+e^- annihilation experiments. These interference effects are examined. It is noted that these effects are independent from those observed in neutrino reactions, since in some models neutral currents couple to electrons and not to neutrinos. Both the case where the electrons and positrons are polarized along their direction of motion and the case where they have opposite polarizations, which are both orthogonal to the orbit plane of the storage ring are considered. (JFP)

17174 STRUCTURE FUNCTION $\nu W_2^\gamma(\nu, q^2)$ OF THE PHOTON IN A GENERALIZED VECTOR-MESON DOMINANCE MODEL. Schlereth, H. (Technische Hochschule, Aachen). Lett. Nuovo Cim.; 10: No. 9, 386-388(29 Jun 1974).

A model calculation is presented for the structure function of a photon target assuming a complete spin independence of the total cross sections of vector mesons on vector mesons. (JFP)

17175 HYDRODYNAMICAL MODEL OF MULTIPARTICLE PRODUCTION. Duong-Van, M. Ithaca, NY; Cornell University (1973). 169p. University Microfilms Order No. 74-7190.

Thesis (Ph. D.).

At present the topic of production processes is a very popular domain of high energy physics. Employing theoretical ideas based on Landau's hydrodynamical model, it is discovered that the assumptions of scaling in $x = 2p/\sqrt{S}$ (suggested by Feynman) and limiting fragmentation (suggested by Yang) should at best be approximate. Measurements of inclusive production cross section are analyzed, and a critical analysis of recent data and the variables used in their presentation are given. It is concluded that data prefers $S^{1/4}$ rather than logarithmic average multiplicity behavior, and the evidence for a flat rapidity distribution of the secondaries in the central region is not compelling. Except possibly at the very highest available ISR energy, the Landau Gaussian gives an excellent description of the rapidity distribution of the nonleading charged secondaries. The rapidity distribution is cast in a universal (energy dependent) scaling law, and the hydrodynamical model is shown to lead to approximate Feynman scaling except for very small values of x where large deviations from scaling are predicted. The validity of the Gaussian rapidity distribution in the longitudinal distribution leads to the speculation that the transverse distribution at 90° in pp collision should also be Gaussian in the transverse rapidity $y_\perp = 1/2 \ln (E + P_\perp)/(E - P_\perp)$. This prediction is borne out over ten orders of magnitude of the cross section. Also, the hydrodynamical model is extended to give a prediction of the average multiplicity of πp, γp, ep and e^+e^- processes. Finally, speculation is made on the connection of this work to the Feynman parton picture, and it is predicted that the ep elastic form factor is Gaussian in the rapidity of the parton. (Diss. Abstr. Int., B)

Weak

Refer also to abstract 17550.

17176 (COO-2232-B-33) WEAK NEUTRAL CURRENTS. Pais, A.; Treiman, S. B. (Rockefeller Univ., New York (USA); Princeton Univ., N. J. (USA). Joseph Henry Labs.). 1973. Contract AT(11-1)-2232. 27p. Dep. NTIS $4.50.

Stimulated by recent indications that neutral current effects may have been seen in high energy neutrino reactions, several issues are taken that bear on the characterization of neutral hadron currents. Occasional guidance is sought in gauge models of the weak interactions, but the discussion is essentially phenomenological. Special emphasis is given to the question whether the neutral currents have "new" pieces, unrelated to those which appear in electromagnetism and in weak charge changing reactions. Of particular interest here is the question: Are the neutral vector currents conserved? (auth)

17177 (COO-3065-75) MUON–PROTON SCATTERING AT HIGH MOMENTUM TRANSFERS: A TEST OF THE ELECTROMAGNETIC EQUIVALENCE OF THE MUON AND THE ELECTRON. Entenberg, A. B. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Apr 1974. Contract AT(11-1)-3065. 271p. Dep. NTIS $16.75.

Thesis.

Inclusive muon-proton scattering was studied in the kinematic region $.4 < Q^2 < 3.6$ $(GeV/c)^2$ and $.4 < \nu < 5.6$ GeV using mean incident energies of 5.8 and 7.3 GeV. The purpose of the experiment was to test the principle of muon-electron universality by comparing proton electromagnetic structure measured with the muon and that measured with the electron. The experimental arrangement consisted of the Brookhaven muon beam ($\sim 2 \cdot 10^6$ μ^+/400 msec AGS pulse) and an apparatus which included a 48″ liquid hydrogen target and hodoscope and wire spark chamber spectrometers for analysis of incident and scattered muons, respectively. All data were recorded and partially analyzed with two on-line computers which monitored the operation of the experiment. From selected samples of 4891 inelastic and 434 elastic events, the invariant structure functions νW_2 (Q^2, ν) and $G_E^2(Q^2)$ were respectively determined and found to be consistent with their counterparts measured at SLAC. The statistical agreement between the μ–p and e–p inelastic data establishes a new 95% confidence lower limit on the μ–e difference parameter, $\Lambda_D > 5.1$ GeV/c. In the nonrelativistic limit, the inverse square of this parameter is proportional to the difference of the mean-square charge radii of the two particles: $\frac{1}{6}\left(\langle r_\mu^2\rangle - \langle r_e^2\rangle\right) \simeq \Lambda_D^{-2} < (3.9 \cdot 10^{-13}\ \text{cm})^2$. (auth)

17178 (DESY-73/59) HIGHER ORDER WEAK INTERACTIONS AND NEUTRINO PROCESS IN ASTROPHYSICS. Abak, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Dec 1973. 24p. (In German). INIS.

10 figs.; 30 refs. with abstract.

The cross sections and energy losses of the processes $e + \gamma \rightarrow e + \nu + \bar{\nu}$ (photon-neutrinoprocess), $e + e \rightarrow \nu + \bar{\nu}$ (pair annihilation process), $Z + e \rightarrow Z + e + \nu + \bar{\nu}$ (bremsstrahlung's process) and the energy loss rates of the plasma-neutrino process (γ(virt) $\rightarrow \nu$(e) + $\bar{\nu}$(e)) are calculated within the second order V-A theory of weak interactions. Instead of regularizing the integrand occurring as a result of the closed lepton lines, an invariant cutoff value is introduced. The matrix elements, and thus the cross sections as well as the energy loss rates for processes taking into account diagrams of second order, can be expressed in terms consisting of the first-order matrix elements and a tensor of second order. Finally, some astrophysical consequences of the assumed electron-neutrino interaction are discussed. (CB)

17179 (JINR-E2-7912) NEUTRAL CURRENT AND SIGN OF THE WEAK COUPLING CONSTANT. Bilen'kii, S. M.; Dadayan, N. A.; Khristova, E. Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

Effects of parity violation in processes of scattering of polarized leptons and antileptons on nucleons are discussed. If the structure of weak neutral currents is known, the observation of such effects would make it possible to determine the sign of the weak coupling constant. Effects of parity violation, if the neutral currents have the structure obtained in the framework of the unified theories of weak and electromagnetic interactions, are discussed in detail. (auth)

17180 (NAL-CONF-74/50-THY) NEUTRINO PHYSICS: THEORETICAL CONSIDERATIONS. Lee, B. W. (National Accelerator Lab., Batavia, Ill. (USA)). May 1974. 15p. (CONF-740418-2). Dep. NTIS $4.00.

From 4th international conference on neutrino physics and astrophysics; Philadelphia, Pennsylvania, USA (26 Apr 1974). (26 Apr 1974).

The discussion of neutrino physics covers kinematics and standard V–A theory, exclusive and inclusive interactions, scaling and the quark parton model, scaling and the light cone, and gauge theories. (JFP)

17181 NEUTRAL CURRENTS IN SEMI-LEPTONIC PROCESSES $\Delta T = 0$. Bernabeu, J. (CERN, Geneva). Lett. Nuovo Cim.; 10: No. 8, 329-332(22 Jun 1974).

The consequences of the assumption that between nonstrange and noncharmed hadrons the matrix element of the last part of the current can be neglected and that consequently the only isoscalar neutral current between nonstrange hadrons is that contained in the electromagnetic one are investigated. Distributions, cross sections, the Weinberg angle, and possible isoscalars in neutral currents are pointed out. (JFP)

17182 DECAY $E^0 \rightarrow \nu\gamma$ IN THE GEORGI–GLASHOW MODEL. Pi, S. Y.; Smith, J. (State Univ. of New York, Stony Brook). Phys. Rev., D; 9: No. 5, 1498-1507(1 Mar 1974).

The decay rate $\Gamma(E^0 \rightarrow \nu_e\gamma)$ in the Georgi-Glashow model where E^0 is a neutral heavy electron is computed. The calculation is done in the renormalizable gauge where $\xi = 1$ and the diagrams have only logarithmic singularities. Analogous results hold for the decay $\Gamma(M^0 \rightarrow \nu_\mu\gamma)$. It is found that $\Gamma(E^0 \rightarrow \nu_e\gamma)/[\Gamma(E^0 \rightarrow e^-e^+\nu_e) + \Gamma(E^0 \rightarrow \mu^+e^-\nu_\mu)]$ ranges from roughly $5\alpha/\pi$ to $15\alpha/\pi$ depending upon the mass of the neutral lepton and charged boson. (auth)

17183 DEEP-INELASTIC CONTRIBUTION FOR THE NEUTRAL CURRENT. Ninomiya, M.; Watanabe, K. (Nagoya Univ., Japan). Phys. Rev., D; 9: No. 3, 803-810(1 Feb 1974).

The effective coupling constants are calculated for the processes $\nu p \rightarrow \nu p$ and $K^+ \rightarrow \pi^+\nu\bar{\nu}$ by taking account of the deep-inelastic contribution. The formal light-cone analysis is applied to get the momentum dependence of the structure functions. It is shown that the lowest-order perturbation is small and that the deep-inelastic contribution for the coupling constant is arranged in the form of sum rules which are derived from U(6) × U(6) quark algebra for the process $\nu p \rightarrow \nu p$. Sum rules are also obtained for the decay process $K^+ \rightarrow \pi^+\nu\bar{\nu}$ by using SU(3) symmetry where the K^+ and π^+ meson mass difference is neglected. By comparing with the experimental upper bound for the neutral current the following results are obtained: The weak boson mass should be less than 11 GeV/c^2 and the local theory of the weak interaction is valid up to 50 GeV. (auth)

17184 CHARGE-SYMMETRY AND ISOSPIN CONSTRAINTS ON PION MULTIPLICITIES IN DEEP-INELASTIC NEUTRINO-INDUCED PRODUCTION. Wilson, W. J. (Harvard Univ., Cambridge, MA). Phys. Rev., D; 9: No. 3, 775-780(1 Feb 1974).

Constraints put on the average pion multiplicities in deep-inelastic neutrino-induced production are found by assuming only the charge symmetry and isospin structure of the usual Cabibbo theory together with scaling. Similar, but more restrictive, results are derived in the context of the quark-parton model. Using the parton model, neutrino-induced production and electroproduction multiplicities are related. (auth)

17185 CONSEQUENCES OF THE SCALE-INVARIANT PARTON MODEL FOR DEEP-INELASTIC NEUTRINO SCATTERING. Casher, A.; Kogut, J.; Susskind, L. (Tel Aviv Univ., Ramat Aviv, Israel). Phys. Rev., D; 9: No. 3, 706-714(1 Feb 1974).

The scale-invariant parton model is used to obtain the consequences of short-distance scale invariance for deep-inelastic neutrino processes. First, the model is generalized to incorporate quantum numbers. The moments of structure functions are power-behaved functions of Q^2, thus violating Bjorken scaling in a systematic way. It is found that the total neutrino cross section and the average neutrino energy loss scale canonically. However, the mean squared momentum $\langle Q^2\rangle$ divided by the neutrino energy E falls as a power of E, thus providing a sensitive test of the breakdown of canonical scaling. Furthermore, the ratio of neutrino to antineutrino cross sections on particular hadrons is predicted to approach unity at extreme energies. These results are compared with those of other theories of the breakdown of canonical scaling. (auth)

17186 NONRELATIVISTIC QUARK MODEL AND OCTET DOMINANCE IN CABIBBO'S WEAK HAMILTONIAN. Naito, S. (Osaka City Univ.). Lett. Nuovo Cim.; 10: No. 4, 168(25 May 1974).

The interesting result is obtained that P-wave decays of hyperons are forbidden in the nonrelativistic quark model. On the other hand, this difficulty does not occur in the nonrelativistic symmetric quark models such as the three triplet, color, para-quark models, etc.; in these models it is found that both 1 and 1′ are even by using the statistics, the spin property, and wave functions of B_1, and B_f. (JFP)

Strong (General)

Refer also to abstract 16692.

17187 (CONF-730804-P3, pp 2296-2300) GROSS FEATURES OF PIONIZATION AND FRAGMENTATION AT HIGH ENERGIES. Jabs, A. (Trier-Kaiserlautern Univ., Kaiserlautern (F. R. Germany)). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The hypothesis that multiple particle production proceeds via two different processes called pionization and fragmentation is discussed. The characteristics of pionization have been specified elsewhere. Fragmentation, for simplicity is tentatively described by the same two-center-statistical formula as pionization, except that the c.m. Lorentz factor of the fragmentation centers is much

larger, of the order of the Lorentz factor of the incoming particles. C.m. production spectra Ed^3N/d^3p are plotted in the variables $\eta = 1n \tan \theta/2$, $y = \tanh^{-1}(p_l/E)$ and $x = 2p_l/\sqrt{s}$. A pionization (double) peak at $\eta = y = x = 0$ and a dip or shoulder at some intermediate value of $|\eta|$, $|y|$, $|x|$ is predicted at high energies. (auth)

17188 (CONF-730804-P3, pp 2311-2316) LORENTZ-FACTORS AND MASSES OF FIREBALLS. Tati, T. (Hiroshima Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Characteristic features of Lorentz-factors and masses of fireballs observed by Japan-Brazil cosmic ray study on extremely high energy nuclear interactions is explained qualitatively by a model of "hadronic matter", proposed previously, based on the theory of finite degree of freedom. (auth)

17189 (CONF-730804-P3, pp 2336-2347) RELEVANCE OF COSMIC-RAY DATA TO INTERACTION MODELS. Wdowczyk, J.; Wolfendale, A. W. (Inst. of Nuclear Research, Lodz, Poland). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A variety of cosmic ray data have been examined in order to see whether the scaling model of Feynman (1969) continues to be valid at energies above 10^{12}eV. A potential complication arises because the cosmic ray interactions relate to target nuclei rather than nucleons but it is argued that the difference should have little effect for the phenomena considered here. The multiplicity of pion secondaries in the cosmic ray case is shown to be considerably in excess of the scaling prediction if, as seems probable, the majority of the primary particles are protons at the energies in question (10^{14}-10^{16}eV). (auth)

17190 (CONF-730804-P3, pp 2348-2355) SCALING MODEL CALCULATIONS OF UNDERGROUND MULTIPLE-MUON PHENOMENA. Mason, G. W. (Brigham Young Univ., Provo, UT); Elbert, J. W. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The Feynman scaling hypothesis is used to project inclusive proton-on-nucleus particle production cross sections from the accelerator energy region to the ultra-high energy region from 1 TeV to 10,000 TeV. Calculations based on this projection are used to make predictions for the muon charge ratio and to make predictions for rates of multiple muon events and separations of muon pairs at underground depths in the range 2×10^5-10^6 g/cm^2. Good agreement between predictions and data provides support for scaling from 1 TeV to 1000 TeV. (auth)

17191 (COO-2232-B-41) SOME GENERAL RESULTS ON THE SIGN OF THE REAL PART OF THE ELASTIC FORWARD SCATTERING AMPLITUDE AT HIGH ENERGIES. Cornille, H.; Hendrick, R. E. (Rockefeller Univ., New York (USA)). 1973. Contract AT(11-1)-2232. 58p. Dep. NTIS $6.00.

For reactions $a + b \to a + b$ and $a + \bar{b} \to a + \bar{b}$ some general results are obtained about the sign of the real part of the forward scattering amplitude taking into account some general experimental features of the total cross sections. These results give numerical bounds on the energy beyond which the real part must remain positive for various reactions, neglecting some low energy effects. For crossing symmetric amplitudes, assuming that beyond the resonance region the symmetric total cross section decreases to a minimum, then increases, and remains a nondecreasing function of energy, one gets a value of the energy beyond which the real part of the symmetric amplitude must remain positive. Assuming that the antisymmetric amplitude satisfies an unsubtracted dispersion relation and that the antisymmetric imaginary part does not change sign and is a nondecreasing function of energy, it is found that the real part of the antisymmetric amplitude is always positive. It is assumed for the determination of the real part of $a + \bar{b} \to a + \bar{b}$ the antisymmetric amplitude satisfies an unsubtracted dispersion relation, $E^{-\alpha}\sigma^A$ does not change sign and does not decrease, or decreases under particular conditions to a constant, after some well defined energy, the total cross-section for $a + b$ decreases to a minimum, then increases sufficiently and remains nondecreasing. Then, one determines the energy beyond which the real part of the forward antiparticle amplitude must be positive. Using the experimental data for $\sigma_{tot}^{K^-p}$ and σ_{tot}^{pp} from threshold up to the observed rise and low energy data for the corresponding antisymmetric parts, it is shown that the real parts of the forward amplitudes for $K^-p \to K^-p$ and $p\bar{p} \to p\bar{p}$ must be positive at, and remain positive beyond, energies close to the minima of $\sigma_{tot}^{K^+p}$ and σ_{tot}^{pp}. (auth)

17192 (JINR-E1-8021) TEST OF THE MODELS OF HADRON COLLISIONS IN INELASTIC INTERACTIONS OF 60 GeV/c π^- MESONS AND 70 GeV/c PROTONS WITH THE NUCLEI (C, N, O) AND (Ag, Br). Abdo, K. M.; Dalkhazhav, N.; Khoshmukhamedov, R. A.; Salomov, J. A.; Shabratova, G. S.; Tolstov, K. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 20p. Dep. NTIS (US Sales Only) $4.00.

Experimental data on the interaction of 60 GeV/c π^--mesons and 70 GeV/c protons with light (C,N,O) and heavy (Ag,Br) nuclei are compared with the results on the models of hadron collisions. These models are divided into two groups: direct particle production models (multiperipheral, dual-resonance, etc.) and two-tact ones (fireballs, fragmentation models, "nova," etc.). The conclusion was drawn in favor of two-tact models. (auth)

17193 (JINR-E2-8048) LARGE-ANGLE SCATTERING AND THE QUARK STRUCTURE OF HADRONS. Matveev, V. A.; Muradyan, R. M.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

On the basis of dimensional quark counting and dynamical interpretation of quark diagrams the explicit form of the differential cross sections of the two-body processes in deep elastic region is obtained. (auth)

17194 (NAL-CONF-74-40-THY) THEORIES OF DIFFRACTION PHENOMENA: A TOUR FOR BEGINNERS AND OTHERS. Abarbanel, H. D. I. (National Accelerator Lab., Batavia, Ill. (USA)). May 1974. 12p. (CONF-740629-1). Dep. NTIS $4.00.

From fifth international symposium on many particle hadrodynamics; Leipzig, F. R. Germany (4 Jun 1974).

A review is presented of several theories of diffraction phenomena in high energy hadron collisions: absorptive models, multiperipheral bootstraps, and Reggeon field theory models. The status of decoupling "theorems" for the Pomeron is discussed. (auth)

17195 (SLAC-168) MULTIPLICITIES AND REGGE POLES IN DEEP HADRON–HADRON SCATTERING. Savit, R. S. (Stanford Linear Accelerator Center, Calif. (USA)). Dec 1973. Contract AT(04-3)-515. 128p. Dep. NTIS $5.45.

Thesis.

Some aspects of hadron–hadron scattering in the deep region are discussed. The deep region can be very roughly characterized as the kinematic region which involves large momentum transfers at high energies. Using ideas related to Feynman's parton model, a formula is derived for the average multiplicity of an inclusive or semi-inclusive experiment in which at least one final-state particle is detected with a large transverse momentum, it is shown how the average multiplicities in these experiments are related to average multiplicities in other high energy reactions. One then turns to a discussion of the relation between the deep and Regge regions in $2 \to 2$ hadronic amplitudes. An integral equation, based on t-channel iterations of two-particle irreducible kernels is derived. It is shown how these graphs generate Regge poles and how their trajectories are connected to the deep scattering Born term. Physical implications of the procedure are then discussed. Next, the approach is generalized to include coupled channel problems. It is then shown how to include the effects of signature in the scheme, and some speculations are given about the physical interpretation of Harari–Rosner duality diagrams and the dynamical origin of the Pomeron pole. (auth)

17196 CLUSTERING IN MULTIPLE PRODUCTION. Chao, A. W.; Quigg, C. (State Univ. of New York, Stony Brook). Phys. Rev., D; 9: No. 7, 2016-2026(1 Apr 1974).

The notion of clustering in many-particle production is defined and applied to experimental situations. It is argued that the existence of clusters is strongly suggested by a number of correlations which have recently been observed in high energy experiments, and call attention to strategies for studying the properties of produced clusters. (auth)

17197 FORMULATION OF DUALITY DIAGRAMS AND UR-CITON SCHEME. Ishida, S.; Otokozawa, J. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 50: No. 3, 1028-1045(Sep 1973).

A unified description to bring in the dual models into the actual world which includes spin and unitary spin nontrivially is presented on the basis of the ur-citon scheme. Scattering amplitudes are represented as a linear combination of beta-functions which is fixed following the implication of duality diagram. In this scheme the well known difficulty of the diagram is resolved, and a new form of duality, "primary-resonant-pole" duality, is valid, where pole-pole duality is satisfied within "primary" nonexotic poles and "resonant" exotic and/or nonexotic poles. It seems to be supported experimentally by the recent observations of exotic peaks in forward or backward differential cross sections. Asymp-

totic behavior of the amplitudes is examined in connection with the diagram. (auth)

Strong (Baryon No. = 0)

Refer also to abstracts 16761 and 17537.

17198 (CONF-730804-P3, pp 2289-2294) MODIFIED FIREBALL MODEL: MULTIPLICITY LAWS IN HADRONIC INTERACTIONS. Sitte, K.; Dardo, M. (Univ., Friedburg i.B.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

An isobar-fireball model is proposed in which hadronic interactions are described by a sequence of absorption and decay, with emission of the nucleon or nucleons involved in the original direction. This leads to an asymptotic $E^{\frac{1}{4}}$ multiplicity relation for N-N interactions, but to an $E^{\frac{1}{5}}$ law in π-N, γ-N, or μ-N collisions. The calculated average numbers of secondaries are in satisfactory agreement with the data on N-N and π-N interactions. The model predicts a fast longitudinal development of air showers, with a cascade maximum close to that found for an $E^{\frac{1}{4}}$ primary multiplicity law. This would remove the basis for the suggestion that the characteristics of hadronic interactions undergo a drastic change at EAS energies. (auth)

17199 (COO-1112-248) PHENOMENOLOGY OF HIGH ENERGY EXCHANGE PROCESSES. Kane, G. L. (Michigan Univ., Ann Arbor (USA)). [nd]. 44p. (CONF-730837-14). Dep. NTIS $5.25.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

The review covers a historical and general survey, amplitude analysis, fixed t (t') zeros. $np \to pn$, $\bar{p}p \to \bar{n}n$, energy dependence, high energy expectations, and the production of resonances and Regge recurrences. (JFP)

17200 (JINR-E2-7929) RELATIVISTIC MODEL OF COMPOSITE MESONS. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 21p. CONF-740713-7). Dep. NTIS (US Sales Only) $4.25.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

The pion is treated as a composite state of a spin $\frac{1}{2}$ fermions c and $\bar{c}$, described by the Euclidean Bethe-Salpeter equation with the local kernel (potential) $f^2(r^2 - a^2)^{-1}$, where $r^2 = (x_c - x_{\bar{c}})^2$. The connection of this potential with the exponentially rising hadronic mass spectrum is discussed, and the parameter a is found to be $a \approx 4$ GeV^{-1}. By solving the massless pion equation and by calculating $\pi \to \mu\nu$ and $\pi \to \gamma\gamma$ it is found that $f^2 = 8$, $M_c^2 \approx 0.9$ GeV, $a \approx 4$ GeV^{-1}. The Johnson equations for C-propagator are approximately solved, with zero bare mass of C-particle, and the possibility of treating the pion as a Goldstone particle is discussed. (auth)

17201 (JINR-P2-7823) MODULUS AND ZEROS OF FORWARD SCATTERING AMPLITUDES AND BOUNDS ON COUPLING CONSTANTS. Dumbrais, O. V.; Stashel, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 22p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

A new method of analyzing of experimental data on $\pi^\pm p$, $K^\pm p$, pp and $\bar{p}p$ forward scattering amplitudes is used to obtain a set of strong correlations between the values of coupling constants, positions of zeros of amplitudes and the values of some integrals over the unphysical region. The method reveals the importance and present insufficiency of our knowledge of the locations of zeros. (auth)

17202 (LBL-2670) ROLE OF THE PION MASS IN TRIPLE-REGGE PHYSICS. Shankar, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 25 Apr 1974. Contract W-7405-eng-48. 17p. (CONF-740713-4). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

An extension is given of the investigations of Abarbanel et al., who examined asymptotic total cross sections in a multiperipheral model and obtained the surprising result that the scale for the cross sections is provided not by μ, the mass of the exchanged pion (as anticipated on geometrical grounds) but by m_V, the central mass of the dominant low energy π-π resonance entering the kernel. The role of the pion mass in triple-Regge physics is clarified by examining the pion pole dominance model for the triple-Regge couplings g_{ijk}. It is found that m_V provides the scale for the inclusive link and that for this reason the couplings g_{ijk} depend very little on the intercept α_k of the exchanged reggeon. In the exclusive links if i = j = pomeron, m_V once again is the only active energy scale, whereas if i = j = R, the reggeons of intercept 0.5 or less, the pion mass enters the couplings g_{RRk} in an essential way. It is shown that the smallness of μ^2/m_V^2 is responsible for the largeness of the ratios g_{RRk}/g_{PPk}. These features of the model, which are in qualitative agreement with experiment, are put to a quantitative test. (auth)

17203 I. UNITARIZATION OF THE PION-PION SCATTERING AMPLITUDES OF CURRENT ALGEBRA AND VENEZIANO'S MODELS. II. Reggeon Amplitude and Duality Sum Rule. Jen, Chian-li. Providence; Brown University (1973). 105p. University Microfilms Order No. 74-3033.

Thesis (Ph.D.).

The Schnitzer unitarization method was improved for the S-wave the pion-pion scattering amplitude so as to satisfy the Roskies crossing relations and the Martin inequalities. By considering the Veneziano's pion-pion scattering formula as the driving force of a full pion-pion scattering amplitude, the S-wave of the pion-pion phase shifts is obtained up to around 1 GeV. The crossing symmetry properties are imposed through the Chew-Mandelstam program. The resulting solutions satisfy the elastic unitarity exactly and the five Roskies crossing conditions up to 10^{-2} and further are consistent with the available experiments. A multichannel approach for $\pi\pi$ is presented in such a way that: The $k\bar{k}$ channel is coupled with $\pi\pi$ through the R-matrix formalism. The correct nearby left-hand cut behavior is given. Unitarity is preserved through the R-matrix formalism. The first five Roskies sum rules are satisfied. By using the S-wave solution, the $k_S^0 - k_L^0$ mass difference and mass distribution of Ke_4^0 decay were calculated. Based on the dual amplitude analysis of the "ditriple" Regge limits in inclusive hadronic reactions, the general properties of the Reggeon-Reggeon amplitude are conjectured and a duality sum rule is suggested. From this sum rule, predictions are made on the two-Reggeon-particle and triple-Reggeon couplings for diffraction dissociations. (Diss. Abstr. Int., B)

17204 OBSERVATION OF AN A_3-AMPLITUDE PHASE CHANGE. Thompson, G.; Badewitz, R. C.; Gaidos, J. A.; McIlwain, R. L.; Paler, K.; Willmann, R. B. (Purdue Univ., Lafayette, IN). Phys. Rev. Lett.; 32: No. 6, 331-334(11 Feb 1974).

A spin and parity decomposition is presented of the $(\pi^+\pi^+\pi^-)$ final state formed opposite a proton by incident 13-GeV/c π^+ mesons. The A_3 enhancement is identified as the 2^- amplitude decaying to $f^0\pi^+$ via an S wave. A change in relative phase is noted between the 2^-S amplitude and the other principal contributions; this is not incompatible with analyses of the $(3\pi)^-$ system. The method employs the University of Illinois three-body partial-wave analysis program. (auth)

17205 ON THE NORMALIZATION OF MESON EIGENSTATES IN FUNCTIONAL QUANTUM THEORY OF THE NONLINEAR SPINOR FIELD. Englert, D.; Stumpf, H. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., A; 29: No. 3, 376-384(Mar 1974).

13 refs. with abstract.

Within the framework of the functional quantum theory of the nonlinear spinor field the normalization of functional eigenstates of scalar mesons is performed. By calculating the lowest approximation of the functional eigenstates for scalar mesons from the dynamical functional equation of the theory, it follows that scalar mesons of positive as well as of negative parity are admitted. Requiring a positive norm for physical particles the result of normalization shows that mesons with positive parity are excluded, while meson states with negative parity give a positive definite norm. This corresponds to experimental experience. (auth)

17206 INCONSISTENCY OF A DUFFIN-KEMMER-PETIAU MODEL FOR MESON DECAY RATES. Seadron, M. D.; Thews, R. L. (Univ. of Arizona, Tucson). Phys. Rev., D; 9: No. 7, 2180-2182(1 Apr 1974).

A Duffin-Kemmer-Petiau model of pseudoscalar mesons (as proposed by Fischbach et al.) is confronted with data on thirteen independent ratios of meson decay rates. With five adjustable singlet-octet ratios as parameters and SU_3-symmetric couplings, this formalism is able to fit only eight of the ratios, while it is inconsistent with experiment on the remaining five ratios. It is concluded that this description is not a viable alternative to the usual Klein-Gordon formalism. (auth)

Strong (Baryon No. = 1)

17207 (CEA-N-1697) INEQUALITIES AND ABSOLUTE LIMITS OF SCATTERING AMPLITUDES. Grammaticou Manolessou, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Feb 1974. 37p. (In French). Dep. NTIS (US Sales Only) $5.00.

A review of inequalities and absolute bounds of the scattering amplitudes recently obtained from axiomatic field theory is given. The Case method is used to obtain a new set of inequalities for $\pi-N$ and $l \geq 4$. (auth)

17208 (CONF-730804-P3, pp 2320-2325) SYSTEMATICS FOR ELASTIC SCATTERING OF ELEMENTARY PARTICLES. Libby, L. M. (Univ. of California, Los Angeles). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

The function $(d\sigma/dlnt)^{\frac{1}{2}}$ against $(t)^{\frac{1}{2}}$ gives rise to a scaling law for elastic scattering of elementary particles on protons, for barycentral angles from 0 to 90°, and for laborstory momenta from 5 to 25 GeV/c. (auth)

17209 (JINR-P2-7868) ISOSPIN BOUNDS AND PHASE CONTOURS IN PION-NUCLEON SCATTERING. Ion, D. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 38p. Dep. NTIS (U. S. Sales Only) $5.00.

The isospin constraints on differential and integrated (unpolarized and polarized) cross sections in the pion-nucleon scattering are investigated. Defining $\Sigma^{(n)}$ -integrated cross sections and using classical Minkowski's and Hölder's inequalities a large class of isospin bounds is obtained. The saturation of the isospin bounds is investigated using the dispersion relation predictions and CERN-theoretic solution for the phase shifts. (auth)

17210 (JINR-E2-7961) SATURATION OF MOST STRINGENT ISOSPIN BOUNDS IN πN SCATTERING. Ion, D. B.; Nichitiu, F. G.; Mihul, A. C. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. Dep. NTIS (US Sales Only) $4.00.

The exact saturation of the most stringent isospin bounds in the pion-nucleon scattering is investigated using the CERN-phase shift analysis. (auth)

17211 RESONANCE AND BACKGROUND ADDITION WITH APPLICATION TO A POLE MODEL OF THE $\Delta(1220)$-RESONANCE. Olsson, M. G. (CERN, Geneva). Lett. Nuovo Cim.; 10: No. 8, 333-337(22 Jun 1974).

A procedure is described for giving the Δ resonance mass and $\Delta N\pi$ coupling constant. It is seen that by using the unitarization method described a pole model can account for the (3,3) phase shift in the low energy region. This result is found with parameters similar to those derived from dispersive analyses or fits to the scattering lengths or crossing-symmetric expansion parameters. (JFP)

17212 ISOSPIN ANALYSIS OF PERIPHERAL $\overline{K}\pi\pi$ PRODUCTION IN $K^-N \rightarrow \overline{K}\pi\pi N$ REACTIONS. Cautis, C. V.; Markytan, M.; Widder, F. (Institut fuer Hochenergiephysik, Vienna). Lett. Nuovo Cim.; 10: No. 8, 345-354(22 Jun 1974).

Since the isospin structure of the data is possible only if all $\overline{K}\pi\pi N$ final states produced in K^--nucleon interactions are considered together with some indirect consequences of isospin invariance, the peripheral production of the $K\pi\pi$ system in the reaction $K^-N \rightarrow (\overline{K}\pi\pi)N$ is considered. It is assumed that the interaction proceeds through the t-channel exchange of an object of isospin $K = 0,1$ and that the $K\pi\pi$ system is produced in a state with $I = \frac{1}{2}, \frac{3}{2}$. The amplitudes and cross sections are discussed. (JFP)

17213 GLORY EFFECT IN PION-PROTON SCATTERING. Viano, G. A. (Univ., Genoa). Nuovo Cim.; 22A: No. 1, 1-10 (1 Jul 1974).

The backward peaks in positive pion-proton elastic scattering are interpreted as due to a glory effect, analogous to the optical glory, which explains the strong enhancement in the backward scattering of light by small water droplets. The mathematical formalism of the model is deduced through a Watson-Sommerfeld transform of the partial-wave expansion of the scattering amplitude. (auth)

17214 THERMODYNAMICAL-MODEL CALCULATION OF THE ENERGY-TEMPERATURE RELATION FOR MESON FIREBALLS AND ITS APPLICATION TO πp REACTIONS. Gerhold, H. R.; Buschbeck, B. (Oesterreichische Academie der Wissenschaften, Vienna). Nuovo Cim.; 22A: No. 1, 39-56(1 Jul 1974).

In the framework of the thermodynamical model of Hagedorn and Ranft the energy density of a "π-fireball"(i.e. one conserved π in the interaction volume) is computed exactly. Then using this result and considering the reaction $\pi^+p \rightarrow \pi^- +$ anything at 16 GeV/c the transverse-energy spectrum of the outgoing pions at fixed c.m. rapidity y^* and its variation with y^* are calculated. Comparison with experimental data is made. The behavior of the transverse energy spectra at different c.m. rapidities at ISR energies is discussed. (auth)

17215 πN SCATTERING AMPLITUDE ANALYSIS: EFFECT OF EXPERIMENTAL ERRORS ON AMPLITUDE UNCERTAINTY. Miller, R. C. (Argonne National Lab., IL); Yokosawa, A.; Johnson, P. Nuovo Cim.; 22A: No. 1, 99-108(1 Jul 1974).

Results of a study on the uncertainties of and possible improvements in determination of πN scattering amplitudes at $p_{lab} = 6.0$ GeV/c are given. The precision gained in determining the helicity amplitudes by more accurate measurements of various observables is discussed. The method presented can be adapted for a study at regions of energy and momentum transfer different from those covered. (auth)

17216 POLE-EXTRAPOLATION FROM THE K^+-p FORWARD SCATTERING AMPLITUDES. Kariya, T. (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 50: No. 3, 891-898(Sep 1973).

The method of extrapolation introduced by Cuilli-Cutkosky-Deo is applied to estimate the PYK coupling constant from the K^+-p forward scattering amplitude. The low energy K^--p data combined with the data used in the analysis by Chao and Pietarinen are used. The result is $g_A^2 + 0.8g_T^2 = 27 \pm 1$, which is much larger than their result and hence indicates how important the low energy K^--p data in the analysis are. Since Martin and Perrin presented K^--p data which contradict Dumbrais, Dumbrais and Queen's compilation used in the present analysis are the coupling constant corresponding to this choice of the data is also estimated, and the quantity $g_A^2 + 0.8$ $g_T^2 = 11\frac{1}{2}$ is obtained. However, if one discards all the K^--p data in the momentum range from 0.3 to 2 GeV/c, the predicted coupling constant and real part strongly support the former choice. (auth)

17217 FACTORING DUAL AMPLITUDE WITH MANDELSTAM ANALYTICITY AND Kp BACKWARD SCATTERING. Mestries, L. G.; Tuan, R. H. (Laboratoire de Physique, Orsay, France). Lett. Nuovo Cim.; 10: No. 9, 379-385(29 Jun 1974).

A theoretical explanation of the energy dependence of the backward K^-p elastic scattering is discussed. The purpose is to apply a model which is considered to have more realistic analyticity properties than previous models, namely, resonances have finite widths without introducing ancestors, Regge behavior even on the real axis, factorization when the extension to N points is made, the scattering amplitude satisfying dispersion relations if the trajectory is asymptotically bounded, crossing symmetry imposed by construction, and Mandelstam analyticity. (JFP)

17218 MEASUREMENT OF p-p INCLUSIVE CROSS SECTIONS AT VERY HIGH ENERGY. Ratner, L. G. (Argonne National Lab., IL); Ellis, R. J.; Vannini, G.; Babcock, B. A.; Kisch, A. D.; Roberts, J. B. Phys. Rev., D; 9: No. 5, 1135-1161(1 Mar 1974).

The differential inelastic cross section $Ed^3\sigma/dP^3$ was measured for particles produced in very high energy proton-proton collisions at the CERN Intersecting Storage Rings. The inclusive reaction $p + p \rightarrow x +$ anything, where x was a π^+, K^+, or proton was studied. The momenta of the two colliding beams varied from 15.3 to 26.5 GeV/c. This was equivalent to a single beam of 500 to 1500 GeV/c hitting a target. The dependence of $Ed^3\sigma/dP^3$ on the transverse and longitudinal moments of the outgoing particles, $P_\perp$ and $P_{||}$ was measured. These particles were detected with a spectrometer containing magnets and scintillation and Cherenkov counters. The first two magnets steered particles with the correct $P_\perp$ and $P_{||}$ down the axis of the spectrometer. The third magnet deflected the particles vertically for momentum analysis. A coincidence of the five scintillation counters indicated an event and the Cherenkov counters tagged it as a pion, kaon, or proton. The luminosity was measured by the Van der Meer method. It was found that when $Ed^3\sigma/dP^3$ was plotted against $X = P_{||}/P_{max}$, it was energy-independent from 12 to 1500 GeV, especially for π^+ data. This supports a type of scaling suggested by Feynman and Yang et al. At small X, the pion cross section has a flat maximum, while the proton cross section decreases slightly. When plotted against $P_\perp^2$, the pion and proton cross sections both behave as at lower energies: $\sim\exp(-4.0P_\perp^2)$. The pion cross section has a distinct forward peak $\exp(-10P_\perp^2)$ which is absent in the proton case. The K^+/π^+ ratio is about 10%, with rather poor statistics. (auth)

17219 DOUBLE-REGGE-POLE ANALYSIS OF $K^+n \rightarrow K^+\pi^-p$ AT 9 GeV/c. Yen, W. L. (Indiana Univ., Indianapolis); Meiere, F. T.; Carmony, D. D. Phys. Rev., D; 9: No. 5, 1210-1215(1 Mar 1974).

A study of the diffraction dissociation of the neutron from the reaction $K^+n \rightarrow K^+\pi^-p$ at 9 GeV/c is reported. The data are compared with a double-Regge-pole-exchange model of Berger. Good agreement with the data is obtained for distributions in $M(p\pi^-)$, $M(K^+\pi^-)$, t_{np}, the Toller angle, the Treiman-Yang angle,

the proton production angle, and the Van Hove angle. The $p\pi$ mass dependence of t_{KK} is also well described. (auth)

17220 ESTIMATE OF THE POMERANCHUKON-p CUT FOR π-NUCLEON SCATTERING. (Univ. of Mexico). Phys. Rev., D; 9: No. 5, 1435-1443(1 Mar 1974).

Assuming the existence of nonsense wrong-signature zeros (NWSZ) in inclusive reactions a parametrization of $g^{p}_{pp}(t)$ for small t is proposed, and then this coupling is estimated phenomenologically. Using the value of $g^{p}_{pp}(t)$ the contribution of the ρ-P cut to the total πN cross section is estimated and the polarization in π^-p charge-exchange scattering is calculated as a ρ-pole ρ-P cut interference. It is found that it is possible to obtain a fairly good fit to the polarization for values of parameters that are consistent with experiment, and furthermore, it is found that the fit to the polarization is very sensitive to the small-t behavior of $g^{p}_{pp}(t)$. (auth)

17221 MINIMAL REGGE MODEL FOR MESON-BARYON SCATTERING: DUALITY, SU(3), AND PHASE-MODIFIED ABSORPTIVE CUTS. Egli, S. E.; Duke, D. W.; Dean, N. W. (Iowa State Univ., Ames). Phys. Rev., D; 9: No. 5, 1365-1384(1 Mar 1974).

A model is presented which incorporates economically all of the modifications to simple SU(3)-symmetric dual Regge-pole theory which are required by existing data on $0^-\frac{1}{2}^+ \rightarrow 0^-\frac{1}{2}^+$ processes. The basic assumptions are no-exotics duality, minimally broken SU(3) symmetry, and absorptive Regge cuts phase-modified by the Ringland prescription. First it is described qualitatively how these assumptions suffice for the description of all measured reactions, and then the results of a detailed fit to 1987 data points are presented for 18 different reactions. (auth)

17222 MODEL-INDEPENDENT TESTS OF THE ON-SHELL PION-NUCLEON WARD IDENTITIES. Scadron, M. D.; Thebaud, L. R. (Univ. of Arizona, Tucson). Phys. Rev., D; 9: No. 5, 1544-1558(1 Mar 1974).

A dispersion-theoretic method is developed to determine the axial-vector background amplitudes appearing in the on-shell πN Ward identities. These current-algebra constraints are then found to be completely consistent with low-energy data and a nucleon σ term of 73 ± 21 MeV. All threshold s- and p-wave scattering lengths are correctly predicted by the model-independent approach. (auth)

17223 COMPARISON OF A DUAL RESONANCE MODEL WITH SPIN WITH THE REACTIONS $\pi^+p \rightarrow \omega\Delta^{++}$, $\pi^-p \rightarrow \omega n$, $\pi^-p \rightarrow \rho^0 n$, AND $\pi^-p \rightarrow B^-p$. Aurenche, P. (Univ. of Illinois, Urbana). Phys. Rev., D; 9: No. 5, 1531-1543(1 Mar 1974).

The model for $\pi N \rightarrow \pi\omega N$ scattering constructed previously is applied to the four quasi-two-body reactions $\pi^+p \rightarrow \omega\Delta^{++}$, $\pi^-p \rightarrow \omega n$, $\pi^-p \rightarrow \rho^0 n$, and $\pi^-p \rightarrow B^-p$. It is found that reasonable agreement with the data is obtained for the features of the model which do not involve the B meson. It is also found that B exchange is too small to account for the unnatural-parity contribution to the two ω-production reactions, indicating that the ρ-ρ cut might be important in these processes. (auth)

17224 DUAL RESONANCE MODEL WITH SPIN FOR THE REACTION $\pi N \rightarrow \pi\omega N$. Aurenche, P. (Univ. of Illinois, Urbana). Phys. Rev., D; 9: No. 5, 1514-1530(1 Mar 1974).

A dual resonance model with spin is constructed for the reaction $\pi N \rightarrow \pi\omega N$. The invariant amplitudes are parametrized as sums of five-point (Bardakci-Ruegg) functions in such a way that the scattering amplitude satisfies the following properties: correct spin-parity structure in all meson channels to leading order, correct Regge limits, correct residues at the lowest poles on all trajectories. The only parameters of the model are coupling constants, for which several sets of constraints are derived. A prediction is also made for the D-wave/S-wave ratio in the decay $B \rightarrow \pi\omega$. (auth)

17225 BREAKDOWN OF THE DRELL-YAN RELATION IN A BOUND-STATE MODEL DUE TO SPIN COMPLICATIONS. Kinzelbach, W. K. H. (Stanford Univ., CA). Phys. Rev., D; 9: No. 3, 765-771(1 Feb 1974).

The influence of spin factors on the validity of the Drell-Yan relation is investigated in the framework of the Drell-Lee bound-state model for the nucleon. Calculations are performed after introducing an infinite-momentum-frame parametrization. It turns out that in one of the two spin combinations looked into, the relation has to be modified. (auth)

Strong (Baryon No. ≥ 2)

17226 (COO-3533-28) MUELLER-REGGE POLE DESCRIPTION OF PIONIZATION IN PROTON-PROTON SCATTERING. Geer, K. A.; Amann, R. F. (Syracuse Univ., N.Y. (USA), Dept. of Physics). Oct 1973. 14p. (SU-4205-28). Dep. NTIS $4.00.

The Mueller-Regge Pole formalism is applied to single pion inclusive data in pp scattering. The data is described for $P_{lab} \geq 12$ GeV/c, $y_{lab} \geq 0.65$, and $p_\perp = 0.2, 0.4, 0.8$. (auth)

17227 (INIS-mf-1168/2, pp vp 15p) MESON EXCHANGE CURRENTS IN THE TWO-NUCLEON SYSTEM. Riska, D. O. (State Univ. of New York, Stony Brook). 1973.

Some examples of reactions in the two nucleon systems are considered to illustrate meson exchange currents. (JPL)

17228 (JINR-E2-7873) RELATIVISTIC PHASE EQUATIONS AND NUCLEON-NUCLEON SCATTERING. Amirkhanov, I. V.; Grechko, V. E.; Dement'ev, R. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 22p. Dep. NTIS (US Sales Only) $4.25.

Phase shifts of nucleon-nucleon scattering in the energy region from 0 to 300 MeV were calculated on the basis of the relativistic phase equations. The results of calculations are considered in comparison with analogous data obtained by others. (auth)

17229 (JINR-E2-7916) MULTIPLICITY MOMENTS IN A SEMI-CLASSICAL COMPOSITE MODEL FOR PROTON-PROTON COLLISIONS AT HIGH ENERGIES. Govorkov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 16p. Dep. NTIS (US Sales Only) $4.00.

The scaling in the behavior of the multiplicity moments is accounted for by the Van Hove overlap function being a Gaussian in impact parameter within a semi-classical composite model for proton-proton collisions at high energies. The construction of a proton out of three quarks is shown, according to the experimental data, to be more preferable. (auth)

17230 DEUTERON WAVE FUNCTION AT SMALL DISTANCES. Moravcsik, M. J.; Ghosh, P. (Univ. of Oregon, Eugene). Phys. Rev. Lett.; 32: No. 6, 321-324(11 Feb 1974).

It is shown that the tensor polarization in elastic electron-deuteron scattering at large but presently attainable momentum transfers is supersensitive to the deuteron wave function within 0.5 fm, but insensitive to the percentage of D state assumed. This may give the first practical method to learn something directly about the two-nucleon interaction in the core. (auth)

17231 THEORY OF HIGH ENERGY DEUTERONS INTERACTION WITH NUCLEI. Akhiezer, A. I.; Berezhnoi, Yu. A.; Soznik, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 4, 643-650(Apr 1974). (In Russian).

Elastic scattering and splitting of deuterons as well as stripping reaction are studied on the basis of a diffraction model. The estimated differential and integral cross sections of the stripping reaction of deuteron by Al, Cu and Pb nuclei are in agreement with experimental data. (auth)

17232 CORRELATIONS BETWEEN CHARGED PARTICLES IN A DIFFRACTIVE DISSOCIATION MODEL. Baier, R.; Widder, F. (Univ., Graz). Z. Phys.; 266: No. 5, 385-390(Feb 1974).

An analytically solvable model of the single excitation diffractive type is investigated. It is assumed that a factorizable Pomeron ($\alpha_p(0) = 1$) excites a cluster, which subsequently decays through a multiperipheral mechanism with pure meson exchanges. Thus various charge structures can be incorporated. For the charged particle multiplicity distribution in inelastic p-p scattering Wroblewski's law, i.e., the experimentally found linear dependence of the dispersion on the mean multiplicity, is derived. (GE)

17233 FIELD-THEORETICAL APPROACH TO NUCLEON-NUCLEON DYNAMICS. Bessis, D. (CEN de Saclay, Gif-sur-Yvette, France); Turchetti, G.; Wortman, W. Nuovo Cim.; 22A: No. 1, 157-223(1 Jul 1974).

The usual approach to nucleon-nucleon dynamics is based on the potentials derived from the one-boson exchange approximation. The aim is to investigate the dynamical content of simple Lagrangians, depending at most on one free parameter, and where the pion is the only source of nuclear forces. Due to the pseudoscalar nature of the pion it is essential to use a fully relativistic formalism: indeed the nucleon negative-parity states, which are taken into account, appear to play a fundamental role especially at zero energy. The inadequacy of the Born series is overcome by applying to the Green's function an approximation (Padé approximation) derived from variational principles; this approximation enjoys unitarity, analyticity and bound-antibound-state poles. The results obtained for the standard Yukawa Lagrangian and the nonlinear σ-model, which fulfils the current algebra constraints, prove that the one- and two-pion forces are sufficient to reproduce quite well all the phase shifts up to 50 MeV, while from 50 to 400 MeV some of the lowest waves still require further improvement. The in-

version in the S-waves (the $^3P_0$ changes sign) is still lacking but the introduction of the ω-meson in the Lagrangian and inclusion of all possible couplings between physical and unphysical states (some of them were neglected) should provide it. (auth)

17234 CHARGE MULTIPLICITY DISTRIBUTIONS AND A KNO-SCALING PUZZLE. Schleisinger, J. (Univ., Mons, Belgium). Lett. Nuovo Cim.; 10: No. 8, 323-328(22 Jun 1974).

An attempt is made to predict the behavior of the charge multiplicity distribution without invoking previous assumptions for 50 to 303 GeV/c pp data. It is found that these data are well reproduced by the compound Poisson distribution with parameter being simple functions of n_{ch} and f_2. It is noted that the way in which σ_{incl}, n_{ch}, and f_2 conspire to make the distribution exhibit KNO scaling up to ISR energies while lacking the right functional dependence. (JFP)

17235 TWO-COMPONENT CHEW-PIGNOTTI MODEL AND POSSIBLE DUAL INTERPRETATION. Jones, S. T. (Univ. of Alabama, Birmingham). Phys. Rev., D; 9: No. 3, 667-672(1 Feb 1974).

A two-component Chew-Pignotti model of hadron-hadron interactions is considered in the strong-ordering approximation. When the model is fitted to experimental multiplicity moments, values are obtained for the two meson trajectories involved and their couplings. It is found that the results can be interpreted in terms of the dual model of Lee. The model lacks short-range correlations, but fits the single-particle spectrum and multiplicity moments adequately. (auth)

17236 ANALYSIS OF $\bar{p}p$ ANNIHILATIONS AT 7 GeV/c USING MULTIPARTICLE VARIABLES. Alexander, G.; Dagan, S.; Fridman, A.; Grunhaus, J.; Nussinov, S.; Oren, Y. (Tel-Aviv Univ., Ramat Aviv, Israel). Phys. Rev., D; 9: No. 3, 649-653(1 Feb 1974).

The six- and more-pion $\bar{p}p$ annihilation channels are studied in terms of multiparticle variables evaluated event by event. In the analysis several newly proposed variables are utilized in addition to others previously introduced. Comparison between the data and a single-particle limited-transverse-momentum phase space suggests a multiperipheral mechanism for the six- and seven-pion annihilation processes. On the other hand, the nine-pion channel was found to be adequately described by a phase-space-like process. (auth)

17237 DECK-MODEL CALCULATIONS OF $\pi^-C \to \pi^+\pi^-\pi^-C^*_{4.44}$. Cutler, R. T. (Univ. of Illinois, Urbana). Phys. Rev., D; 9: No. 3, 676-683(1 Feb 1974).

A Reggeized Deck model is used to calculate $\pi^-C \to \pi^+\pi^-\pi^-C^*_{4.44}$ using a Monte Carlo approach where events are generated from the model and then analyzed as if they were experimental data. A partial-wave fit is made to the results of the calculation. The effect of absorption by the nuclear matter of the outgoing dipion system is estimated, and a brief effort is made to calculate $\pi^-C \to \pi^+\pi^-\pi^-C$, where the final state of C is not observed. (auth)

17238 MODEL FOR p-p DIFFRACTION. Davidson, M. (Univ. of Illinois, Urbana). Phys. Rev., D; 9: No. 3, 797-803 (1 Feb 1974).

Previous work on π-π scattering is generalized to include the p-p case. A fixed-pole solution is found for the p-p scattering amplitude. After approximating the residue of this pole, a comparison is made with high energy data from the CERN ISR. The one-parameter model explains several aspects of these data. (auth)

17239 DECAY MODE $^7Be_\Lambda \to \pi^- + {}^1H + {}^1H + {}^1H + {}^4He$. Davis, D. H. (University Coll. of Science and Tech., London); Tymieniecka, T.; Juric, M.; Krecker, U.; Kielczewska, D.; Sacton, J.; Cantwell, T.; Montwill, A.; Moriarty, P. Lett. Nuovo Cim.; 10: No. 4, 139-143(25 May 1974).

The study of final-state interactions between nuclear products in the decay of the $^7Be_\Lambda$ is based mainly on the analysis of the distribution of the relative energies defined as the sum of the kinetic energies of the particles in their center-of-mass system. The most striking result is in the distribution of the relative energies of the (p-p-α) system. The shape of the experimental spectrum suggests the presence of final-state interactions between the nuclear decay products. This conclusion is supported by the study of the kinetic-energy spectrum of the decay pion. (JFP)

17240 LIMITING BEHAVIOUR OF INCLUSIVE BARYON SPECTRA. VI. Inclusive Reactions and Urbaryon Rearrangement Diagrams. Kinoshita, K.; Noda, H. (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 50: No. 4, 915-925(Sep 1973).

Single-particle distributions of protons and hyperons in proton-hadron collisions are examined. The shapes and energy dependences of them are described by "an interpolation formula" proposed previously, by assuming the dominance of the H $\oplus$ P type which exhibits the limiting behavior in the proton fragmentation region. Especially, the behavior of them at small x agrees with the double-Regge aspect of the formula. In addition to the H$\oplus$P type, the diffractive contribution is important for the proton spectra at $x \sim 1$, and the development of a dip in the spectra at $x \simeq 0.9$ is due to the decrease of the latter with increasing energy. (auth)

17241 APPLICATION OF THE GELL-MANN-GOLDBERGER FORMULA TO THE OFF-ENERGY-SHELL PROTON-PROTON T-MATRIX. Bajzer, Z. (Ruder Boskovic Inst., Zagreb). Nuovo Cim.; 22A: No. 2, 300-312(21 Jul 1974).

An exact Gell-Mann-Goldberger (GG) formula for the two-body off-energy-shell t-matrix is derived. It follows that the simple extension of the matrix elements in the usual on-shell GG formula, which has so far been used in the literature, is not exact. It is explicitly shown that in the case of the Coulomb plus Yamaguchi potential such an extension cannot even be considered as an approximation. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 17535.

17242 ANOMALOUS THRESHOLDS AND THE REALIZATION OF CHIRAL SYMMETRY. Brehm, J. J. (Univ. of Massachusetts, Amherst). Phys. Rev., D; 9: No. 6, 1818-1824(15 Mar 1974).

The work of some others is followed in a study of chiral-symmetry breaking based on the linear σ model in the semiclassical approximation. By this procedure the masses of the mesons are known in terms of the symmetry-breaking parameters. Therefore, in those terms, one can analyze the system for the possible occurrence of anomalous thresholds corresponding to the bound-state properties of the scalar mesons. We found that when the critical parameter in the symmetric Lagrangian is such that a Goldstone symmetry limit can occur, then the anomalous threshold does not manifest itself by emerging to the physical sheet when mass continuation is performed; instead, the anomalous singularity stays out on the physical sheet and never disappears from it. Conversely, the system has an anomalous threshold with familiar emerging behavior when the critical parameter admits only the normal symmetry limit. (auth)

17243 GROUP THEORY OF THE SPONTANEOUSLY BROKEN GAUGE SYMMETRIES. Li, L. F. (Stanford Univ., CA). Phys. Rev., D; 9: No. 6, 1723-1739(15 Mar 1974).

The patterns of symmetry breaking in the gauge theories are investigated systematically in the general rotation groups and unitary groups, with Higgs scalars in the various representations up to second-rank tensors. The occurrences of the fermion mass relations and pseudo-Goldstone bosons are also discussed in various cases. (auth)

17244 INDECOMPOSABILITY OF POINCARE-GROUP REPRESENTATION OVER MASSLESS FIELDS, AND THE QUANTIZATION PROBLEM FOR ELECTROMAGNETIC POTENTIALS. Matthews, P. M. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., D; 9: No. 6, 1706-1710(15 Mar 1974).

Considering the little group of the Poincaré group associated with a lightlike four-vector, one determines, explicitly, in global form, the representation of this little group over the space of covariant massless fields transforming according to some irreducible representation $D^{(m,n)}$ of the homogeneous Lorentz group. The little-group representation is indecomposable and nonunitary. Exploiting the knowledge of this representation for $D^{\frac{1}{2},\frac{1}{2}}$ (i.e., vector fields), it is proven that the vector transformation property of the electromagnetic potentials A_μ together with the invariance of their two-point Wightman functions (in momentum space) make it impossible to have any nontrivial scheme of quantization in which the metric is positive-definite or even semidefinite. The proof does not involve any axioms beyond those required for the definition and invariance of the Wightman functions; in particular, one does not assume the spectral condition, local commutativity, or any equations of motion or constraint. (auth)

17245 NECESSARY CONDITIONS FOR THE EXISTENCE OF HAMILTONIAN ACTIONS OF LIE GROUPS AND COMPLEXIFICA-

TION OF THE INDUCED LIE ALGEBRAS OF FUNCTIONS ON THE PHASE SPACE. (A Critical Analysis). Bunchaft, F. (Univ., Naples). Lett. Nuovo Cim.; 10: No. 4, 149-155(25 May 1974).

A critical examination is made of the approach of complexification of Lie algebras of functions on a sympletic manifold, applied in the search for conditions necessary for the existence of Hamiltonian actions of a general Lie group. The main result is that this approach cannot yield, on its own, a method which could put to work the structural features of complex Lie algebras in a manner independent of the features of the real Lie algebras. (LBS)

17246 PION PHASE TRANSITION AND PHONON EXCITATION SPECTRUM IN CHIRAL SYMMETRY BREAKING MODEL. Dashen, R. (Institute for Advanced Study, Princeton, N. J. (USA)); Manassah, J. T. (American Univ., Beirut (Lebanon)). Phys. Lett.; A; 47: No. 6, 453-454(6 May 1974).

It is shown that in the non-linear σ-model, there is a phase transition when the isospin chemical potential is equal to the meson mass. This result is shown to be generally true in the SU(2) × SU(2) symmetry breaking model. The excitation spectrum is shown to have a stable phonon branch. (auth)

Applications (Electromagnetic and Weak)

17247 ESTIMATION OF THE VACUUM SU(3) BREAKING: AN INVESTIGATION OF SECOND CLASS EFFECTS IN SEMILEPTONIC HYPERON DECAYS AND RADIATIVE CORRECTIONS TO $\Sigma^+ \to \Lambda e^+ \nu$ DECAYS. Eimerl, D. Evanston, IL; Northwestern University (1973). 186p. University Microfilms Order No. 74-7736.

Thesis (Ph. D.).

Unitary symmetry is considered. The SU(3) properties of the vacuum are studied in the $(3,\bar{3}) \oplus (\bar{3},3)$ model of chiral symmetry breaking. It is pointed out that recently derived lower bounds on $\Delta_\kappa(0)$, the propagator of the divergence of the strangeness changing vector current at zero four-momentum squared, based on K_{l3} decay, together with the conventional assumptions of the model, severely restrict the range of values $\Delta_\kappa(0)$ may take. On estimation of $\Delta_\kappa(0)$ from K_π phase shifts, it is shown to be barely compatible with these restrictions, and some ways out of the problem are considered. Implications for K_{l2} decay are examined, and data on this decay seem to require a value of $\Delta_\kappa(0)$ incompatible with the conventional $(3,\bar{3}) \oplus (\bar{3},3)$ model. In the second part a model of the matrix elements of currents between baryonic states is presented, which is consistent with chiral symmetry realized through Goldstone bosons, vector meson dominance, and available data on these matrix elements. In the model of effects of SU(3) breaking are examined. An Ademollo-Gatto theorem is found for first class covariants, and the pseudotensor term induced by mass and coupling constant splittings is estimated. The results are compared with available data on the semileptonic decays of hyperons, and the conclusion drawn that it is not yet proven that second class currents are present in these decays. Electromagnetic corrections to the beta decays of the sigma hyperons to the lambda hyperon are examined with a view to possible discovery of a charge asymmetry of nonelectromagnetic origin in these decays. A single renormalization of G, the weak coupling constant, renders both rates finite, the dominant electromagnetic asymmetry coming from electromagnetic mixing of the neutral hyperon system, or from the hypercharge densities of the physical hyperons. Estimates of the electromagnetic asymmetry are presented. (Diss. Abstr. Int., B)

Applications (Strong)

Refer also to abstract 17404.

17248 F-g VERSION OF THE SL(6,C) GAUGE THEORY. Isham, C. J. (Imperial Coll. of Science and Tech., London); Salem, A.; Strathdee, J. Phys. Rev., D; 9: No. 6, 1702-1705 (15 Mar 1974).

The recently proposed SL(6,C) gauge-invariant theory describing a nonet of tensor mesons (f) interacting with hadrons is written in a generally covariant formulation. Assuming that leptons interact directly with gravitons (g), a generally covariant as well as SL(6,C) gauge-invariant f-g mixing term is introduced to describe the gravitational interaction of hadrons as well as to provide masses for the SU(3)-octet f's and for a singlet mixture of the f and g fields. The gauge symmetries are broken spontaneously and it is shown that a second orthogonal combination of f-g fields remains massless, representing "true" gravity. (auth)

Scattering Theory

Refer also to abstracts 17169 and 17526.

17249 (ITF-73-174E) EXPANSION FOR THE SCATTERING AMPLITUDE OF FOUR SPINCARRYING PARTICLES WITH SPHERICAL TENSOR OPERATORS OF THE GROUP O(3,C). Kirschbaum, D. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 14p. Dep. NTIS (US Sales Only) $4.00.

A group structure is determined on the manifold of analytical S-matrix elements. Each of these S-matrix elements is given on the manifold of two-particle momentum vectors τ_s, τ_t, τ_u; this description favors a definite frame of reference for each physical channel. After analyzing the spin quantum numbers of S-matrix elements with definite subgroup structures, an integral expansion is given of S-matrix elements on functions, which are given on the whole complex Mandelstam plane, i.e., for all physical channels. The kernels of this integral expansion are the matrix elements of spherical tensor operators of the group O(3,C). (auth)

17250 (JINR-P2-7937) PARAMETRIZATION OF THE BINARY REACTION AMPLITUDES. Rerikh, K. V.; Chavleishvili, M. P.; Sheftel, M. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A possible parametrization of the binary reaction amplitudes basing on the introduction of new invariant variables is considered. A unique description of the scattering at small and large angles at high energies is obtained. (auth)

17251 LINEAR REPRESENTATION OF THE LEFT HAND CUT IN THE SCATTERING OF SPINLESS PARTICLES. Gibson, L. R. Athens, OH; Ohio University (1973). 71p. University Microfilms Order No. 74-7638.

Thesis (Ph. D.).

The feasibility and accuracy of replacing the Balázs method of approximating the left hand cut for the partial wave amplitude to spinless particles by a series that is linear in certain unknown constants is investigated, and the method is applied to a known test function. The Balázs method is a method of replacing the left hand cut by a series of poles, the positions and residues of which must be numerically determined by matching the resulting N/D output with the known amplitude in the gap between the left and right hand cuts. In a physical problem this amplitude in the gap is calculated from the crossed channels. Use of the expansion for the cut developed immediately gives equations that are linear in the expansion constants and no repetitions are required. In addition, since each term in the linear series used has a cut over the same region as the unknown function, the final amplitude has a cut over the original region instead of being replaced by poles. Two methods were tested with the same known function: when the entire left hand cut was approximated by a series, and when the near part of the cut was retained explicitly and the rest approximated by a series. Although the first method was too slowly convergent to be of much practical use, the second method reproduced the known function quite well. (Diss. Abstr. Int., B)

17252 MINIMAL HIERARCHY OF FADDEEV-TYPE EQUATIONS FOR N-PARTICLE SCATTERING. Karlsson, B. R.; Zeiger, E. M. (Stanford Univ., CA). Phys. Rev., D; 9: No. 6, 1761-1768(15 Mar 1974).

Operators are introduced, which make up the kernels of all N-body Faddeev-type scattering equations. The hierarchy of these operators, and the equations they satisfy, are shown to provide the minimal description of all Faddeev-type formalisms. By means of this hierarchy, the N-body formalisms proposed by Yakubovskii and by Alt, Grassberger, and Sandhas are shown to be equivalent. The four-body case is treated in some detail. (auth)

17253 GENERALIZED EULER-POCHHAMMER INTEGRAL REPRESENTATION FOR SINGLE-LOOP FEYNMAN AMPLITUDES. Wu, A. C. T. (Univ. of Michigan, Ann Arbor). Phys. Rev., D; 9: No. 2, 370-373(15 Jan 1974).

Kershaw's power-series representation for the single-loop Feynman amplitudes is cast into a new integral representation which, as a generalization of the Euler-Pochhammer type, is closer in spirit to the Veneziano representation than the conventional Feynman-parameter representation. Landau singularities, which are obscure in the power-series expansion, are recovered in the new integral representation. Explicit calculation is carried out for the cases $N = 3$ and $N = 4$. (auth)

17254 STATIONARY APPROACH TO COULOMB SCATTERING. Zorbas, J. (Univ. of Toronto). Lett. Nuovo Cim.; 10: No. 4, 121-125(25 May 1974).

The relation between the distorted waves depending on a complex energy and the Coulomb distorted waves is derived for nonrelativistic two-body scattering. It is shown that if one first multiplies the α-channel distorted waves which depend on the complex energy $E^{(\alpha)} = E_{(\alpha)} \pm i\epsilon$ by ϵ-dependent factors, then the limit $\epsilon \to +0$ can be performed to obtain the α-channel Coulomb distorted waves. (LBS)

17255 FUNCTIONAL MASS OPERATOR FORMALISM AND THREE-PARTICLE EQUATIONS. van der Merwe, P. duT. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Lett. Nuovo Cim.; 10: No. 4, 126-128(25 May 1974).

The functional method for two-particle interactions is complemented by a method referred to as structure analysis utilizing three-particle equations to find a compact formulation in terms of higher particle dynamics. For simplicity, the method is exposed by implementing the ideas as specialized to the mass operator itself, which in turn serves as the generator for other attributes. An immediate consequence of the analysis is the expression of the parquet sums by declustered two-particle scattering matrices which act as inhomogeneous terms of the three-particle equations. (LBS)

17256 VARIATIONAL PROCEDURE FOR THREE-BODY CORRELATION. Osman, A. (Cairo Univ.). Lett. Nuovo Cim.; 10: No. 4, 134-138(25 May 1974).

Short-range correlations in nuclear matter are studied. A variational procedure is proposed to obtain the best two- and three-body correlation factors. (LBS)

17257 COORDINATE REPRESENTATION OF SEPARABLE POTENTIALS. Ahmad, S. S. (Univ., Padua); Pisent, G. Nuovo Cim.; 22A: No. 1, 79-98(1 Jul 1974).

The general properties of separable potentials are studied with particular reference to the co-ordinate representation. With some special choices of the form factors, a detailed analysis of the problem is possible, up to the determination of the S-matrix pole trajectories. This has been done in particular for a separable potential with square-well form factors, in cases of S- and P-wave interaction. (auth)

17258 UNIFIED FORMULATION OF THE VARIATIONAL METHODS IN SCATTERING THEORY. Singh, S. R.; Stauffer, A. D. (York Univ., Downsview, Ont.). Nuovo Cim.; 22B: No. 1, 139-152(11 Jul 1974).

The Schwinger and Kohn variational methods are derived in a unified manner from the approximation theory of linear operators in Hilbert space. The analytic basis behind their relation with the method of the Padé approximants is clarified. The present formulation has enabled one to derive some known results in variational methods and the Padé approximants relatively briefly and simply. (auth)

17259 REDUCTION OF AMBIGUITIES OF THE SCATTERING AMPLITUDE BY LINEAR CONSTRAINTS. Langbein, W. (Univ., Trier, Kaiserlautern, Ger.). Nuovo Cim.; 22A: No. 2, 279-299 (21 Jul 1974).

The phase ambiguities of the scattering amplitudes compatible with a given set of experimental data are discussed. Expansions of the amplitudes into truncated partial-wave series and also rational series which solve fixed-t dispersion relations are considered. In the former case the phase ambiguity is reduced by the optical theorem, in the latter case this occurs if the Born term is known. The bounds obtained on the remaining number of amplitudes rely only on the property that rational parametrizations are used which are linearly constrained at some point of the complex $\cos\theta$ or energy plane. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

17260 (JINR-P4-7895) SEARCH FOR THE BOSE-CONDENSATE IN He-II. Kozlov, Zh. A.; Aleksandrov, L.; Zagrebnov, V. A.; Parfenov, V. A.; Priezzhev, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The inelastic neutron scattering spectrum ($k \approx 14$, 1 A^{-1}) was analyzed based on the regularized iteration Gauss-Newton process. As a mathematical model the two-Gaussian form is used in correspondence with the assumption that the scattering law can be represented as two Gaussian curves representing the contribution of the condensate and overcondensate parts. From the point of view of the statistical criterion at $\theta = 4.2$°K the one-Gaussian model is the best one which testifies to the absence of the Bose-condensate at this temperature. At $\theta = 1.2$°K the best one is the two-Gaussian model, the Bose-condensate fraction value being $\rho_0/\rho = 0.029 \pm 0.013$. The work was performed at the Laboratories of Neutron Physics, Theoretical Physics and at the Laboratory of Computation and Automation. (auth)

17261 OSCILLATORY FLOW OF UNSATURATED He II FILMS. Mountfield, K. R. Ithaca, NY; Cornell University (1973). 131p. University Microfilms Order No. 74-6333.

Thesis (Ph.D.).

Oscillatory flow between two chambers connected by a capillary has been observed for unsaturated helium films ranging in thickness from 25 A to 300 A at a temperature between 1.1 K and 0.6 K. The oscillations were initiated by a small heat pulse applied to one chamber and monitored by observation of the film thickness by means of a capacitor in each chamber. The period of oscillation was studied as a function of mean film thickness and temperature. The effect of preplating nitrogen or neon on the surface before adding helium was noted on the period and the flow rates between the two chambers observed upon adding gas to increase the film thickness. (Diss. Abstr. Int., B)

17262 SPIN WAVES IN ANISOTROPIC SUPERFLUID ^{3}He. Maki, K. (Tohoku Univ., Sendai); Ebisawa, H. J. Low Temp. Phys.; 15: No. 3–4, 213-229(May 1974).

Spin waves in the A phase of superfluid ^{3}He are studied theoretically. It is assumed that the condensate in the A phase consists of the P-wave triplet pairs of the type suggested by Anderson and Brinkman. It is shown that the spin wave mode with a finite energy gap exists throughout the A phase. In particular at T = 0K the dispersion of the spin wave is given by, for $vq < \Delta$, $\omega^2 = \omega_0^2 + 2(1-\bar{I})A\Delta^2 + \frac{1}{3}(1-\bar{I})v^2q^2$ where ω is the spin wave energy, $\omega_T = [\omega_0^2 + 2(1-\bar{I})A\Delta^2]^{1/2}$ is the nuclear magnetic resonance energy, v is the Fermi velocity, q is the wave vector of the spin wave, and $\bar{I} = IN(0) = -\frac{1}{4}Z_0$ is the Landau–Fermi liquid parameter. (auth)

17263 SELF-CONSISTENT APPROXIMATIONS IN THE THEORY OF TRIPLET PAIRING SUPERFLUIDITY IN ^{3}He. Tewordt, L. (Univ., Hamburg). J. Low Temp. Phys.; 15: No. 3–4, 349-365(May 1974).

A self-consistent and "spin-conserving" approximation scheme in the theory of triplet pairing superfluidity in ^{3}He is developed in terms of normal and anomalous Gor'kov Green's functions and the antisymmetrized interaction function. Both the normal and anomalous self-energy parts must be derived from the same diagrammatic approximation to a certain functional Φ, which in turn can be obtained from an approximation to the thermodynamic potential. With the help of this prescription the particle-hole T-matrix approximation to the normal system is generalized by taking into account that in the super-fluid state the spin fluctuations are propagated also by pairs of anomalous Green's functions. The resulting equations for the components (with respect to the Pauli matrices) of the normal and anomalous self-energy parts and the T-matrix are treated in a self-consistent way. Explicit expressions for the effective interaction kernels occurring in the gap equations are given in terms of normal and anomalous "bare particle-hole susceptibilities." The results are discussed in connection with the original theory of Layzer and Fay and the recent one of Anderson and Brinkman. (auth)

17264 SUSCEPTIBILITY OF LIQUID ^{3}He NEAR 1 K. Sykes, J. (Duke Univ., Durham, SC). J. Low Temp. Phys.; 15: No. 3–4, 387-406(May 1974).

The susceptibility of an interacting system of fermions is calculated by expanding the partition function in a way similar to the semiclassical expansion. The interactions enter through the radial distribution function g(q) and an effective temperature T_{eff} in the momentum distribution function. By making simple approximations for g(q), it is shown that the present theory contains most other high-temperature theories as special limiting cases. When the available experimental data for the liquid structure function, which is related to the Fourier transform of g(q), are used and a plausible choice for T_{eff} is made, reasonable agreement is obtained with the experimental results for the susceptibility of liquid ^{3}He near 1 K. (auth)

17265 MICROSCOPIC APPROACH TO THE THEORY OF ROTON INTERACTIONS IN SUPERFLUID HELIUM. Rajagopal, A. K.; Bagchi, A.; Ruvalds, J. (Univ. of Chicago). Phys. Rev., A; 9: No. 6, 2707-2719(Jun 1974).

A microscopic theory of quasiparticle interactions in liquid helium is derived in terms of the density-fluctuation variables. The collective-variable approach follows closely the formalism of Sunakawa and co-workers, who have previously calculated in detail the three-phonon interaction. In this paper, the direct scattering of quasiparticles is calculated from first principles. The amplitude for the scattering of two excitations is derived in the general form to leading order in perturbation theory. It is then used to estimate the effective roton-roton coupling in terms of the analysis based on the collective-variable approach. The microscopic theory yields an attractive coupling of two rotons, but the coupling strength is an order of magnitude larger than the phonomenological estimates based on experiments. A renormalization procedure is outlined which reduces the strength of the roton-roton interaction, which may bring the coupling in closer agreement with previous estimates. Thus the renormalization of vertex functions and quasiparticle propagators is of great importance in relating microscopic theories to phonomenological parameters obtained from experiments. (auth)

17266 *ANISOTROPIC SUSCEPTIBILITIES AND NMR SHIFTS* IN SUPERFLUID ^{3}He. Engelsberg, S.; Brinkman, W. F.; Anderson, P. W. (Bell Telephone Labs. Inc., Murray Hill, NJ). Phys. Rev., A; 9: No. 6, 2592-2597(Jun 1974).

The effect of terms describing the anisotropic susceptibilities on the NMR shifts observed in superfluid ^{3}He is discussed. It is shown that they are such that the isotropic susceptibility in the expressions of Leggett is replaced by the correct temperature-dependent susceptibilities. The anisotropy energies of the Balian–Werthamer (BW) state are calculated and shown to be of order $(\gamma H/T_c)^2$ times those pinning the spin and orbit coordinates in either the BW or Anderson-Brinkman-Morel state. (auth)

17267 CHARGE CARRIERS IN LIQUID He II PRODUCED BY SPARK DISCHARGE. Date, M.; Hori, H.; Toyokawa, K. (Osaka Univ.). J. Phys. Soc. Jap.; 35: No. 4, 1179-1183(Oct 1973).

A new method of producing various charge carriers and neutral impurities in liquid He II was developed by making a spark discharge plasma just above the liquid surface. This method can produce + or – charge carriers of $>10^{11}$/cc and the optical and transport properties of these charge carriers were investigated. It was found that the plasma in the liquid shows a strong recombination effect by the irradiation of light having an energy larger than W_b, where W_b (0.6 eV) is the dissociation energy of an electron from the electron bubble. (auth)

Superconductivity

Refer also to abstract 16146.

17268 (CALT-822-61) AMORPHOUS SUPERCONDUCTING LANTHANUM–GOLD ALLOYS OBTAINED BY LIQUID QUENCHING. AEC Research and Development Report No. 53. Johnson, W. L.; Poon, S. J.; Duwez, P. (California Inst. of Tech., Pasadena (USA). W. M. Keck Lab. of Engineering Materials). Apr 1974. Contract AT(04-3)-822. 11p. Dep. NTIS $4.00.

Results of x-ray diffraction studies, electrical resistivity, and critical magnetic field measurements are reported for amorphous superconducting lanthanum–gold alloys obtained by liquid quenching with $T_c = 3.4$°K. An extremely short electronic mean free path in these alloys results in an unusually small coherence length and a subsequent high upper critical field. (auth)

17269 (COO-3311-13) HYDROSTATIC EXTRUSION OF ALUMINUM CLAD SUPERCONDUCTOR WIRE. Final Report. Story, J. M. (Lehigh Univ., Bethlehem, Pa. (USA). Inst. for Metal Forming). 3 Jun 1974. Contract AT(11-1)-3311. 70p. Dep. NTIS $6.50.

A study was made of the acceptable combinations of process variables for the production of a Nb–Ti (56–44%) superconducting alloy in a pure aluminum matrix by hydrostatic extrusion. Conditions for sound flow and defective flow are shown on plots of % reduction in area versus die semi-cone angle. The variables affecting the observed flow mode in hydrostatic extrusion of bimetal rod are reduction in area, die semi-cone angle, core to matrix strength ratio, core to matrix diameter ratio, bond strength between the core and the matrix, friction between the billet and the die, and receiver chamber pressure. Single core billets were extruded into atmospheric receiver pressure with reduction in area, die semi-cone angle, and area ratio being varied. Single core billets were extruded into receiver pressure with reduction in area and die semi-cone angle being varied. Billets with three cores were extruded with reduction in area, die semi-cone angle, friction, and receiver pressure being varied. In all cases there was a light mechanical bond between the two materials produced by interference fitting the cores into drilled holes. Results showed that increasing the receiver pressure increases the range of acceptable process variables to produce sound flow. Although it was possible to produce sound flow, the results were not always consistent and repeatable, largely owing to the great difference in strength between the soft Al and the hard superconductor. Also, with the present equipment and preparation methods it was difficult to accurately control the bond strength. It is expected that the beneficial effect of receiver pressure will be even more pronounced with a tighter control on bonding. The production of fine, multi-filament superconductor wire with a pure aluminum matrix was impossible. (23 figures) (auth)

17270 OBTAINING A CONSISTENT SET OF THERMODYNAMIC VARIABLES FOR REAL SUPERCONDUCTORS. Bostock, J. (Massachausetts Inst. of Tech., Cambridge); Mathews, W. N. Jr.; Gregory, W. D. Phys. Status Solidi (b); 62: No. 2, 573-584(1 Apr 1974).

A method is presented for obtaining a consistent set of thermodynamic parameters and temperature-dependent thermodynamic variables for a real superconductor. The method depends upon determining a temperature-dependent effective interaction strength for the particular material. Conversely, given the effective interaction strength for the superconductor, the thermodynamic variables as functions of temperature can be obtained. The method is illustrated for Al, V, Ta, Nb, and Pb. The results of this approach and the McMillan theory of the critical temperature are compared for Nb, Pb, and the In–Tl alloy system. (auth)

17271 MAGNETIC FLUX DISTRIBUTION IN TYPE I SUPERCONDUCTING THIN FILMS. Kunze, U.; Lischke, B.; Rodewald, W. (Technische Univ., Berlin). Phys. Status Solidi (b); 62: No. 2, 377-383(1 Apr 1974). (In German).

Patterns of the magnetic flux distribution in superconducting thin films (Pb,In) in perpendicular magnetic fields have been observed by decoration with small iron particles. The dependence of these intermediate state structures on the film thickness is compared with current theories. Below a critical thickness of about $d_c \approx 0.1$ μm a change from the intermediate state structures to the two-dimensional mixed state is observed. (auth)

17272 MOESSBAUER EFFECT IN SUPERCONDUCTING FILMS OF TIN EVAPORATED TOGETHER WITH AN ETIOPORPHYRIN TIN COMPLEX. Alkseevskii, N. E.; Tsebro, V. I. (Inst. of Physics Problems, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 4, 1419-1425(Apr 1974). (In Russian).

The Mossbauer effect for Sn^{119} nuclei is studied in an etioporphyrin tin complex and in superconducting tin films evaporated together with the organic complex. It is shown that the Mossbauer absorption spectra in such films, which are a finely dispersive granulated system of metallic particles in the organic component matrix, differ from the absorption spectra of the pure etioporphyrin complex. The main differences are the weak temperature dependence of the absorption probability and the decrease of the absorption line width of the organic component. Isotopic exchange between tin in the metallic granules and tin in the etioporphyrin complex is observed. No change is observed in the chemical shift. The results confirm the suggestion previously made that no such interaction arises between the tin granules and organic complex which could appreciably affect the superconducting transition temperature of the system. (auth)

17273 INTERACTION BETWEEN s–n-DOMAIN WALLS AND LATTICE DEFECTS IN TYPE-I SUPERCONDUCTORS. Riedel, H.; Kronmueller, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (b); 63: No. 1, 231-240(1 May 1974).

The interaction between crystal dislocations and s–n-walls in type-I superconductors is treated on the basis of the micromagnetic equations of superconductors. The elastic properties of the s–n-walls are described by quasi-dislocations and the interaction force with the dislocations is derived from a generalized Peach–Koehler formula. A statistical analysis of the total force exerted by randomly distributed dislocations on s–n-walls yields characteristic differences between the ΔV-effect and the nonlinear elastic effects (ΔE-, P-effect) concerning the mean wavelength of the field of force and the dependence on the dislocation density. The relative changes of the magnetization curve caused by wall pinning due to dislocations are shown to amount to 5 to 15% for large plastic deformations. (auth)

17274 EXACT SOLUTION OF A NEW SUPERCONDUCTING STATE. Fink, H. J.; Poulsen, R. S. (Univ. of California, Davis). Phys. Status Solidi (b); 63: No. 1, 317-324(1 May 1974).

An exact solution of a new superconducting state is obtained which exists for dc currents larger than the critical current in thin wires. The order-parameter is zero at all times at certain points in the whisker, thereby permitting the phase to slip at a constant rate, a consequence of which is a dc potential difference between the separate singly-connected superconducting regions. These solutions are periodic in space and lead to voltage steps in the dc voltage–current characteristic. It is proven in the limit when the zeros of the order-parameter are far apart that these solutions are stable. (auth)

17275 VORTICES IN SUPERCONDUCTORS OF THE SECOND TYPE. Shmidt, V. V.; Mkrtchyan, G. S. Usp. Fiz. Nauk; 112: No. 3, 459-490(Mar 1974). (In Russian).

Eddy filaments in hard superconductors were studied. The study is conducted in the region of weak magnetic fields, where linear electrodynamics are applicable, by means of which it is possible to give a simple physical interpretation both to the properties of the insulated eddy and to the interaction of the eddies with each other and with the surface of the superconductor. An analysis is carried out on a series of examples of the effect of the external superconductor boundary on the eddy structure. From these examples it follows that the eddy lattice is stable with respect to transverse current transport even in an ideally homogeneous sample. Estimates are presented on the maximum transport current at which the stability of the eddy structure is still conserved. The role of internal superconductor surfaces is also shown with examples of eddy interaction with a cylindrical cavity and with the separation boundary of two different superconductors. (55 references) (SJR)

17276 IMPURITY EFFECT ON THE ANISOTROPY OF THE UPPER CRITICAL FIELD IN TYPE II SUPERCONDUCTORS. Yamamoto, M.; Ohta, N.; Ohtsuka, T. (Tohoku Univ., Sendai). J. Low Temp. Phys.; 15: No. 3–4, 231-247(May 1974).

The effect of the reduction in mean free path on the anisotropy of the upper critical field H_{c2} has been studied in Nb by adding Ta and Mo as impurities. It is found that impurities suppress the degree of anisotropy, in qualitative accord with the theory of Hohenberg and Werthamer, which shows that in cubic materials with a nonspherical Fermi surface anisotropy arises from nonlocal corrections to the GLAG theory. The results were analyzed by fitting the observed anisotropy curves to an expansion in Kubic harmonics. It is found that the second harmonic coefficient A_2, which depends on first nonlocal corrections, decreases initially with addition of Ta or Mo according to theory, but tends to level off to an approximately constant value in the dirty limit, where it should vanish. The value of the third harmonic coefficient A_4, which depends on higher-order nonlocal terms, vanishes rapidly with the addition of impurity, the rate of decrease being more rapid for Mo. It is also found that the presence of an impurity does not affect the temperature dependence of A_2 for both Nb–Ta and Nb–Mo systems and A_2 for the Nb–Ta system and has an approximately similar effect as for pure Nb. (auth)

17277 COHERENT POTENTIAL APPROXIMATIONS FOR NONMAGNETIC WEAK-COUPLING SUPERCONDUCTING ALLOYS. II. Lustfeld, H. (Univ., Hamburg). J. Low Temp. Phys.; 15: No. 3–4, 269-280(May 1974).

Green's functions and correlation functions are calculated in a nonmagnetic superconducting alloy within the framework of the coherent potential approximation. Although, under alloying, the properties of the normal state will change more or less strongly, it is shown that certain superconducting properties will be very similar to those of the pure metal. These include the diverging density of states at frequencies equal to the order parameter Δ and the behavior of the correlation functions at very low frequencies and frequencies near 2Δ. The penetration depth of a magnetic field is calculated and can be a highly asymmetric function of the alloy concentration. (auth)

17278 LATTICE THERMAL CONDUCTIVITY OF NORMAL AND SUPERCONDUCTING NIOBIUM. Anderson, A. C.; O'Hara, S. G. (Univ. of Illinois, Urbana). J. Low Temp. Phys.; 15: No. 3–4, 323-333(May 1974).

The lattice thermal conductivity of superconducting and normal Nb as limited by the interaction of phonons with electrons has been deduced from measurements in the superconducting state. The results indicate that the mean free paths of transverse and longitudinal phonons are similar, $\sim 4 \times 10^{-5} T^{-1}$ (cm K), in the normal state. Comparison is made with measurements on other metals. A compilation is included of the ratio of lattice conduction in the normal state to that in the superconducting state, based on the BCS theory of superconductivity. (auth)

17279 TRANSITION FROM TYPE I TO TYPE II BEHAVIOR AND THE DENSITY OF STATES IN THIN INDIUM FILMS. Gray, K. E. (Argonne National Lab., IL). J. Low Temp. Phys.; 15: No. 3–4, 335-347(May 1974).

Thin indium films in a perpendicular magnetic field were studied by electron tunneling. From measurements of the density of states and critical field it was concluded that the films undergo a transition from type I to type II behavior at a thickness of 2700 Å at 0.4 K. In thicker films the number of flux quanta in a bundle increases smoothly with thickness and supercooling effects associated with type I were observed. The thin films all have the same density of states and are reversible, indicating type II behavior. A comparison is made with other determinations of the critical thickness. The densities of states in type II lead, indium, and aluminum films are found to be different but show a consistent trend with transition temperature. Calculations only exist for bulk, dirty type II materials and are not applicable to these bulk type I materials. (auth)

17280 LOCAL STRUCTURE AND THERMODYNAMIC PROPERTIES OF CLEAN TYPE II SUPERCONDUCTORS NEAR H_{c1} AT ARBITRARY TEMPERATURE. Pesch, W.; Kramer, L. (Kernforschungsanlage, Juelich, Ger.). J. Low Temp. Phys.; 15: No. 3–4, 367-386(May 1974).

An iterative procedure has been developed to solve Eilenberger's version of the Gor'kov equations numerically. The method has been used to compute the structure of flux lines and the lower critical field for clean superconductors as a function of temperature. Some information on the vortex lattice has also been obtained by means of a circular cell approximation. A pronounced reduction in the size of the core region (measured, e.g., in units of the temperature-dependent coherence length) with decreasing temperature was found; this results in considerably steeper slopes of the order parameter and the current density at the vortex center. There are indications that, among other peculiar effects, these slopes diverge for $T \to 0$. The field at the center of the isolated vortex apparently increases with decreasing temperature down to $T = 0$. The results are compared with experiments and with similar calculations for the dirty limit. (auth)

17281 APPLICATIONS OF THE JOSEPHSON EFFECT. Benacka, S.; Ondris, L. (Ustav Elektrotechnicky, Bratislava). Cesk. Cas. Fys.; 24: No. 3, 225-236(1974). (In Czech).

Possible applications of the dc and ac Josephson effects are dealt with. Basic conceptions on the Josephson effects, a description of the most common types of weak links and some realized applications are briefly given. (auth)

17282 MAGNETIC FIELD DEPENDENCE OF THE SURFACE REACTANCE OF SUPERCONDUCTING TIN AT 174 MHz. Josephson, B. D. (Cambridge Univ., Eng.). J. Phys., F (London); 4: No. 5, 751-756(May 1974).

The magnetic field dependence of the surface reactance of superconducting tin was measured at a frequency of 174 MHz. In the perpendicular field configuration (RF and static fields perpendicular to each other) the behavior observed was approximately that expected from the Ginzburg–Landau theory in the static limit. In the parallel field configuration complicated behavior was observed, even the sign of the reactance change being different at different temperatures. Near T_c there was a region where the reactance change has approximately linear dependence on the magnitude of the applied field, instead of the quadratic dependence expected in fields that are not too large. (auth)

17283 SOME EFFECTS OF PHONON DYNAMICS ON ELECTRON LIFETIME, MASS RENORMALIZATION, AND SUPERCONDUCTING TRANSITION TEMPERATURE. Allen, P.B.; Silberglitt, R. (National Science Foundation, Washington, D. C. 20550). Phys. Rev. B 9: No. 11, 4733-4741 (1 June 1974).

Effects of the dynamical properties of phonons on the electronic properties of metals are treated through the use of the phonon spectral weight function. It is shown that the leading behavior of the electron quasiparticle lifetime is lowered to quadratic in the frequency or temperature from the cubic behavior which is well known to occur for infinitely sharp phonons. Explicit evaluations of $1/\tau$ are made using an extension of the Debye model which allows for a finite phonon lifetime. The mass-enhancement parameter λ is discussed and is shown formally to be related to the static phonon propagator. Thus if there is a difference between the phonon relaxation at zero frequency and at the phonon frequency, it is possible for the phonon frequencies which determine λ to differ significantly from the peak frequencies observed in inelastic neutron scattering. The implications of these results for superconducting transition temperatures are discussed with particular reference to recent neutron scattering experiments in Nb_3Sn. (auth)

17284 INTRINSIC TWO-PHONON-EXCHANGE MECHANISM OF SUPERCONDUCTIVITY AND ENHANCEMENT OF T_c. Kumar, N. (Department of Physics, Indian Institute of Science, Bangalore 560012, India). Phys. Rev. B 9: No. 11, 4993-4945 (1 June 1974).

It is shown that the intrinsic two-phonon terms occurring in first order in the electron–phonon interaction Hamiltonian can give rise to (i) an essential doubling of the interaction phase space (BCS cutoff) and (ii) an attractive pairing interaction proportional to the phonon occupation numbers. This suggests a possible enhancement of the superconductive transition temperature in the presence of high-frequency acoustic field. (auth)

17285 SUPERCONDUCTIVE SPECIFIC-HEAT TRANSITION IN A MAGNETIC FIELD. Bray, A.J. (The Physics Laboratories, The University of Kent, Canterbury, Kent, England and Center for Theoretical Physics, University of Maryland, College Park, Maryland 20742). Phys. Rev. B 9: No. 11, 4752-4759 (1 June 1974).

The specific-heat transition of bulk and thin-film superconductors in a uniform magnetic field is studied within the Ginzburg–Landau model using a screening treatment of the order-parameter fluctuations. For the bulk case, reasonable quantitative agreement is obtained with the experimental results of Barnes and Hake. (auth)

17286 TRANSPORT PROPERTIES OF NONEQUILIBRIUM SUPERCONDUCTORS. Chang, J.; Scalapino, D.J. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. B 9: No. 11, 4769-4774 (1 June 1974).

The model developed by Owen and Scalapino for superconductors with excess quasiparticles at thermal equilibrium with the lattice was adapted to investigate the transport properties of the nonequilibrium superconductors. Specifically, we have calculated within this model the frequency and temperature dependence of the ultrasonic-attenuation coefficient, the dynamic electric conductivity, and the temperature dependence of the nuclear-spin relaxation time. It is found that in some cases even a small number of excess quasiparticles can change the transport property drastically. (auth)

17287 SUPERCONDUCTIVITY IN METAL-SEMICONDUCTOR EUTECTIC ALLOYS. Tsuei, C.C.; Johnson, W.L. (W. M. Keck Laboratory of Engineering Materials, California Institute of Technology, Pasadena, California 91109). Phys. Rev. B 9: No. 11, 4742-4751 (1 June 1974).

In an eutectic alloy obtained by melting the constituents, alternating domains of metal and semiconductor can exist in a well-defined microscopic array. The possibility of superconductivity arising from an interface interaction between the metal and semiconductor has been investigated. Superconductivity has been observed as a bulk property of some eutectic alloys (e.g., Al–Si and Al–Ge). Transition temperatures well in excess of those for the pure metal were found. The effect of rapid cooling the alloys from the liquid state on the microstructure and on the superconducting properties has been studied. It was found that a decrease in the characteristic domain sizes of the metal and semiconductor was accompained by an increase of the superconducting transition temperature of the alloy. The results suggest that the enhancement of T_c depends on the Fermi energy of the metal. In metal-metal eutectic systems with comparable microstructure, no increase of T_c was observed. Several explanations of the experimental findings are considered. The exciton mechanism discussed by Ginzburg and by Allender, Bray, and Bardeen is considered as a possible means to account for the enhancements of the metal T_c's. (auth)

17288 NEW WAVE-OPERATOR IDENTITY APPLIED TO THE STUDY OF PERSISTENT CURRENTS IN 1D. Mattis, D. C. (Yeshiva Univ., New York). J. Math. Phys. (N.Y.); 15: No. 5, 609-612(May 1974).

It was shown that a large class of backward-scattering matrix elements involving $\Delta k \sim \pm 2k_F$ vanish for fermions interacting with two-body attractive forces in one dimension. (These same matrix elements are finite for noninteracting particles and infinite for particles interacting with two-body repulsive forces.) The results demonstrate the possibility of persistent currents in one dimension at $T = 0$, and are a strong indication of a metal-to-insulator transition at $T = 0$ for repulsive forces. They are ob-

tained by use of a convenient representation of the wave operator in terms of density-fluctuation operators. (auth)

Equipment and Devices

Refer also to abstracts 16584–16586.

17289 (ANL-8080, pp 13.1-13.6) LARGE SCALE APPLICATIONS OF SUPERCONDUCTIVITY. Purcell, J. R. (Argonne National Lab., IL). 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

The history, current uses, and future applications of superconductivity are described briefly. (MHR)

17290 (BNL-18602) TECHNICAL AND ECONOMIC FEASIBILITY OF SUPERCONDUCTING POWER TRANSMISSION: A CASE STUDY. Forsyth, E. B.; Mulligan, G. A.; Beck, J. W.; Williams, J. A. (Brookhaven National Lab., Upton, N. Y. (USA)). 8 Feb 1974. 9p. (CONF-740709-1). Dep. NTIS $4.00.

From Power Engineering Society summer meeting and energy resources conference; Anaheim, California, USA (14 Jul 1974).

The long-range plans of the Long Island Lighting Company include the installation of 4600 MW of generation capacity at nuclear sites on eastern Long Island by the 1990's. A single site, Shoreham, was chosen for this study which would require transmission facilities to the Ruland Road substation, 43 miles away. Conventional 345 kV overhead and underground circuits are planned for this service. For the case study three superconducting cable schemes have been investigated which reflect various technical options. The superconducting cables have been designed to meet acceptable normal and contingency load flow conditions and to withstand maximum short circuit faults. A cost analysis has been made of the complete installation, providing a valuable comparison of the estimated cost of this new technology with conventional methods. The most favorable cost comparison is a two-circuit 345 kV superconducting system, which appears to be about one-half the cost of an all underground 345 kV high pressure oil-filled cable system. No reactive compensation will be required for the superconducting system, whereas extensive compensation is required for HPOF cables over the same distance. The cost estimate for the two-circuit superconducting system is about twice that of 345 kV overhead transmission, which would consist of two double circuits and one single circuit, assuming right-of-way could be obtained. (auth)

17291 OPTIMIZING THE WINDING GEOMETRY OF A SUPERCONDUCTING, INDUCTIVE ENERGY ACCUMULATOR. Troitskii, A. M. Tr. Radiotekh. Inst.; No. 11, 138-141(1972). (In Russian).

A method is presented for determining the parameters of a toroidal inductive energy accumulator which assures a minimum weight of the superconducting winding at a given stored energy. The calculation was carried out on the assumption that the winding thickness is small in comparison to the radius and that the critical characteristics of the superconductor are linear. (SJR)

17292 ^{3}He–^{4}He DILUTION REFRIGERATOR AND LOW TEMPERATURE MEASUREMENT. Nagano, H.; Asami, H.; Oda, Y.; Fujii, G. (Tokyo Univ.). Reito; 49: No. 558, 318-323(Apr 1974). (In Japanese).

A ^{3}He–^{4}He dilution refrigerator was built, and its operation characteristics and construction details are reported. The principle of dilution refrigeration, details of heat exchangers, and a separation still are described. The precautions about heat leaks from surroundings of a cryostat and the temperature measurements at milli-degree temperature region are discussed. (auth)

17293 RESIDUAL FIELD IN SUPERCONDUCTING DIPOLE MAGNET. Greben, L. I. Tr. Radiotekh. Inst.; No. 11, 157-164(1972). (In Russian).

A mechanism is described for the occurrence of residual field in a superconducting magnet, and a method is accepted for calculating this field that is based on a model of the critical state of type II superconductors. Results are presented for calculating the distribution of residual field in the aperture of a dipole magnet. (SJR)

17294 IMPROVEMENTS IN OR RELATING TO SUPERCONDUCTORS. Barber, A. C.; McDougall, I. L. (to Imperial Metal Industries (Kynoch) Ltd.). British Patent 1,342,157. 28 Dec 1973. Filed date 4 Oct 1971. 6p.

A method is described for manufacturing a superconductor that incorporates a superconductive intermetallic compound of at least two elements. The method includes the steps of producing a filament or filaments of at least one of the elements, embedded in and supported by a matrix material. The filaments are then passed into liquid or vapor containing the remainder of the elements to remove part of the matrix material and replace the removed material by a substance comprising the remainder of the elements, and the whole then heated to produce the required compound. Unreacted reinforcing filaments may be incorporated. The matrix material may be Cu, Ag, Ni, or Al, the filaments may comprise Nb, and the remaining elements may be Sn, Al, Ga, V, or Ge. Alternatively the filaments may comprise Si or Cu–Si alloy. The filaments may be twisted about the axis of the superconductor. (UK)

17295 LIFETIME OF THE ZERO-VOLTAGE STATE IN JOSEPHSON TUNNEL JUNCTIONS. Fulton, T.A.; Dunkleberger, L.N. (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 9: No. 11, 4760-4768 (1 June 1974).

We describe an experimental investigation of fluctuations in the measured value of the critical current in Josephson tunnel junctions. The lifetime τ of the zero-voltage state against spontaneous transitions to a nonzero-voltage state is derived from these measurements. The range of τ covered by these measurements runs from 10^{-1} to 10^{-7} sec, with τ decreasing approximately exponentially with increasing current bias. Both thermal-noise-limited and extrinsic-noise-limited situations have been observed. In associated experiments the maximum critical current of these Sn–Sn-oxide–Sn junctions is found to be reduced from the value predicted by weak-coupling theory by a factor of $\simeq$0.92, presumably by strong-coupling effects. (auth)

17296 DEVELOPMENT AND INVESTIGATION OF PULSE SUPERCONDUCTING SOLENOIDS. Batakov, Yu. P.; Barantseva, G. E.; Vasil'ev, V. L.; Gurin, S. P.; Kurdyukova, Z. A.; Kostenko, A. I.; Monoszon, N. A.; Mozalevskii, I. A.; Trokhachev, G. V. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). pp 227-232 of Proceedings of the Third All-Union Conference on the Charged Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973). (In Russian)

The results of a study of a method for preventing the motion of the winding coils of superconducting magnets under the influence of a ponderomotive force by saturating the windings with an insulating compound are reported. The results of a study of the thermal conductivity, thermal capacity, and stability to thermal shock of two compounds prepared on the basis of the epoxide ED-6 and the organosilicone resin K-67 filled with fine-grained powders of boron nitride are reported. The results of the measurement of the transition current for a series of superconducting solenoids differing by the type of impregnating compound, intercoil insulators, geometric dimensions, method of cooling, and construction of the composite conductors are given in tabular form. (INIS)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 17393, 17448, 17457, 17458, 17464, 17496, 17498, 17502, 17513, 17514, 17517, 17717, 17897, 17908, 17913, 17916, 17917, and 17919.

17297 (AERE-R-7682) DISCUS: A COMPUTER PROGRAM FOR THE CALCULATION OF MULTIPLE SCATTERING EFFECTS IN INELASTIC NEUTRON SCATTERING EXPERIMENTS. Johnson, M. W. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1974. 60p. Dep. NTIS (U. S. Sales Only) $6.00. UK £1.00.

A computer program is described which enables the ratio of once-scattered to twice-scattered neutrons detected in an inelastic neutron scattering experiment to be calculated. The program may be used for any sample for which the scattering law is of the form $S(|Q|,\omega)$. (auth)

17298 (CONF-721018-(Vol.2), pp 284-301) MONTE CARLO THREE-DIMENSIONAL MULTIGROUP PROGRAM TRIPOLI. Bourdet, L.; Katz, S.; Nimal, J. C.; Vergnaud, T. (CEA, Fontenay-aux-Roses, France). 1972. (In French).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The Monte-Carlo program TRIPOLI calculates the energy and spatial distribution of neutron fluxes and currents in general three dimensional geometries. The biasing techniques which are introduced allow the treatment of neutron penetration problems through large thicknesses materials within reasonable calculation times. A number of examples of applications of the program are given. (auth)

17299 (CONF-721018-(Vol.2), pp 302-338) SOLUTION OF THE COUPLED INTEGRAL AND DIFFERENTIAL FORM OF THE TRANSPORT EQUATION USING A LEGENDRE POLYNOMIALS SOURCE DENSITY APPROXIMATION IN ANGLE AND SPACE FOR SLAB GEOMETRY. Stepanek, J.; Ligou, J. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Neutron source density approximations in angle and space using a Legendre polynomial expansion are used for solving the integral transport equation in one-dimensional multilayer slab geometry. Different expansions are used for each layer. The number of integral equations is limited because a set of differential equations is used at the same time. The SHERLOCK code based on this method was written mainly for shielding problems, but reactor or cell calculations are also possible. Several numerical applications are given: neutron spectra in light water, neutron penetration in iron-water shieldings, etc. (auth)

17300 (CONF-721018-(Vol.2), pp 339-354) DISCRETE ORDINATES-NUMERICAL INTEGRATION METHOD FOR NEUTRON TRANSPORT EQUATION IN ONE- AND TWO-DIMENSIONAL GEOMETRIES. Takeuchi, K.; Yamaji, A. (Ship Research Inst., Tokai). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A numerical approach to the Boltzmann transport equation is presented for practical calculations of neutron penetration. The scattering integral, with anisotropic treatment of elastic scattering and isotropic treatment of inelastic scattering, is numerically evaluated. A system of coupled one-group integral equations, converted from the energy-dependent transport equation, is calculated by performing line integration along the neutron flight path. Comparisons are given of the calculated results with experimental angular spectra in graphite and water, and with experimental reaction rates in iron-water. (auth)

17301 (CONF-721018-(Vol.2), pp 434-441) SHIELD: A MONTE CARLO PROGRAM TO STUDY NEUTRON TRANSPORT IN SLAB GEOMETRIES USING A PDP-9 COMPUTER. Adams, R. J.; Henry, L. C.; Lokan, K. H. (National Research Council of Canada, Ottawa). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

SHIELD, which makes extensive use of core overlays, is a Fortran IV program, modelled on 05R, which is designed to run on a 16K Digital Equipment Corporation PDP-9 computer. The creation and analysis of a collision tape (10,000 collision histories) takes 90 minutes/cycle, and after each cycle the updated output is preserved, so that the program may be restarted with a minimum of loss. (auth)

17302 (CONF-721018-(Vol.3), pp 757-770) REACTOR SHIELDING AS A SOURCE OF RADIATION. Bolshakov, A. V.; Madeev, V. G.; Rudakov, A. N.; Uksusov, E. I.; Kurchatov, I. V. (Inst. of Atomic Energy, Moscow). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A method is developed for arriving at a two-component definition of the radiation flux within and beyond shielding. Consideration is given to reactor shielding as a source of scattered radiation. Experimentally derived parametric characteristics of the fast-neutron scattering function are given for various materials. The relationship between the scattering function and differential neutron cross sections is analyzed. (auth)

17303 (EUR-5122(Vol.2), pp 967-982) NEUTRON ENERGY DEPOSITION SPECTRA STUDIES. Caswell, R. S.; Coyne, J. J. (National Bureau of Standards, Washington, DC). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Secondary particles (p, α, C, N, etc.) are generated when neutrons interact with tissue. The concern here is with three spectra of these secondary particles: (1) the "initial" spectra which come from neutron cross section information, (2) the "slowing-down spectra" which are obtained from the initial spectra and secondary particle stopping power data, and (3) the "energy deposition spectra" —the spectra of energy depositions by the secondary particles in small tissue volumes, which depend upon both the previous spectra, the geometrical properties of the volume, and upon stopping power and range information. All of these spectra were calculated for a number of energies of monoenergetic neutrons between 60 keV and 14 MeV using analytic methods previously described. Examples will be given of the variation of the spectra and of certain spectral averages such as the frequency and dose averages of lineal energy ($\bar{y}_f, \bar{y}_D$) as a function of neutron energy. Experimental information for comparison exists for spectra of type (3), and it is understood that measurements of spectra of type (1) are underway. (auth)

17304 (IA-1293) ENERGY MOMENTS METHOD FOR GENERATING EFFECTIVE MULTIGROUP CROSS SECTIONS. Gur, Y.; Yiftah, S. (Israel Atomic Energy Commission, Tel Aviv). Jan 1974. 53p. Dep. NTIS (US Sales Only) $5.75.

A new method of preprocessing a basic data library such as ENDF/B, by means of existing codes, is presented. From the preprocessed library, 2 to 3 times as large as a Bondarenko-type library, a weighted average for any weighting function may be calculated easily in a few computer seconds, without reference to the basic data library. A family of functions with terms into which any weighting function can be expanded is used. Group averages of each cross section with respect to terms of the family and a set of shielding factors form the preprocessed library. Two families of functions, $f_n(E)$, are considered, and two methods are given for the expansion of W(E) into each series of $f_n(E)$. Nuclear parameters obtained via these methods are compared with the same parameters obtained by using the exact weighting function. Very good agreement is found. (1 figure, 5 tables) (auth)

17305 (INIS-mf-911, pp 29) EXPLICIT SOLUTIONS OF THE ONE DIMENSIONAL TIME DEPENDENT TRANSPORT EQUATION. Ilamed, Y.; Lemanska, M. (Israel Atomic Energy Commission, Yavne). 1973.

From Israel Nuclear Society annual meeting; Yavne, Israel (26 Jun 1973).

The Lie series method for solving differential equations has been extended to solve initial value problems for the integro-differential equation of the transport of neutrons. For a number of initial conditions it was possible to sum up the series and obtain explicit solutions in a closed form. (INIS)

17306 (JINR-P4-7832) SURFACE FILM EFFECT ON THE ULTRACOLD NEUTRON (UCN) ABSORPTION IN THE TRAP WALLS. Ignatovich, V. K.; Stepanov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The effect of surface films on the absorption coefficient of ultracold neutrons is studied for the case of a single collision with the wall. An estimate is given for the film thickness leading to the experimentally observed decrease of absorption in the Be and glass traps by 10 times. For the case of CCl_4 film this thickness value turns out to be 14 Å. (auth)

17307 (JINR-P14-7979) DIFFRACTION OF POLARIZED NEUTRONS ON A ^{184}W SINGLE CRYSTAL LOCATED IN A MAG-

NETIC FIELD. Aleksandrov, Yu. A.; Mikhalets, R.; Sedlakova, L. N.; Khalupa, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Diffraction of polarized neutrons on a ^{182}W single crystal located in a magnetic field was studied. For reflection (220) there was observed an anomalous increase of the polarization ratio with the increase of the magnetic field. (auth)

17308 (ORNL-RSIC-34(Vol.1)(Rev.)) DEFENSE NUCLEAR AGENCY WORKING CROSS SECTION LIBRARY: DESCRIPTION AND CONTENTS. Roussin, R. W.; Wright, J. B. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 219p. Dep. NTIS $14.00.

The Defense Nuclear Agency (DNA) cross-section library is a working library in ENDF format whose content can be modified and revised whenever the evaluator deems such changes to be necessary. The key to this approach is a selected evaluator, who is then responsible for authorizing changes in evaluations for those elements. The evaluated data are for those materials of interest to DNA, whose cross-section values are in a state of rapid flux, and emphasis is placed on neutron energies up to 20 MeV and on secondary gamma-ray production. The data, along with available documentation, are distributed upon request. The current contents of the library are tabulated. The format used is described. A history of the modifications to the evaluations is summarized. The listing of file 1 information on the tapes is given; this is the evaluator's brief description of his effort, and much useful information can be found therein. Some published reports describing most of the evaluations are listed. (RWR)

17309 (SZS-153, pp 137-142) SPECTRUM OF NEUTRONS BACKSCATTERING FROM A FINITE PHANTOM. Noack, K.; Heinzelmann, B.; Wand, H.; Giessing, R.; Linemann, H. Aug 1973. (In German).

From 4th international symposium on personal dosimetry; Potsdam, F.R. Germany (10 Oct 1972).

The spectrum of neutrons backscattered from a finite phantom was calculated in dependence on neutron energy by means of a Monte Carlo program. (auth)

17310 MONTE CARLO SOLUTION TO THE DIRICHLET PROBLEM WITH THE DOUBLE-LAYER POTENTIAL DENSITY. Hoffman, T. J. (Science Applications, Inc., Huntsville, AL); Banks, N. E. Trans. Amer. Nucl. Soc.; 18: 136-137(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17311 ACCURACY OF THE WHITE BOUNDARY CONDITION IN r-z GEOMETRY. Gelbard, E. M. (Argonne National Lab., IL); Lathrop, K. D. Trans. Amer. Nucl. Soc.; 18: 142(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17312 TRANSPORT EQUATION DIFFERENCE SCHEMES ON MESH CELLS CONTAINING MATERIAL INTERFACES. Hill, T. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 142-143(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17313 CONVERGENCE ACCELERATION OF LINEAR ITERATIONS USING A MODIFIED SYNTHETIC METHOD. Painter, J. W.; Rydin, R. A.; Metcalf, D. R. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 18: 143-144(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17314 AUTOMATIC LOCATION OF COMBINATORIAL GEOMETRY INPUT ERRORS BY COMPUTER. Cohen, M. O.; Beer, M.; Troubetzkoy, E. (Mathematical Applications Group, Inc., Elmsford, NY). Trans. Amer. Nucl. Soc.; 18: 144-145 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17315 CORRECTIONS FOR ANGULAR FLUX VARIATIONS WITHIN RESPONSE MATRIX ANGULAR GROUPS. Filippone, W. L. (Lowell Tech Inst., MA). Trans. Amer. Nucl. Soc.; 18: 145-146(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17316 LIE SERIES PERTURBATION SOLUTION OF THE INVARIANT IMBEDDING REFLECTION EQUATIONS. Hu, T. K.; Zink, J. C. (Univ. of Oklahoma, Norman). Trans. Amer. Nucl. Soc.; 18: 146-147(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17317 COSINE CURRENT TRANSMISSION PROBABILITIES FOR SPHERICAL SHELLS. Westfall, R. M. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 18: 147-148 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17318 NODAL SYNTHESIS METHOD AND IMBEDDED FLUX CALCULATIONS. Wagner, M. R. (Kraftwerk Union AG, Erlangen, Ger.). Trans. Amer. Nucl. Soc.; 18: 152-153(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17319 IMPROVED F-FACTOR INTERPOLATION SCHEME FOR 1DX. Kidman, R. B. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 156-157(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17320 RENSSELAER INTERACTIVE GRAPHICS ANALYSIS SYSTEM. Danchak, M.; Moyer, W. R.; Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). Trans. Amer. Nucl. Soc.; 18: 159(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17321 FAST-NEUTRON SPECTRA IN A BULK SODIUM ASSEMBLY. Mallen, A. N.; Kaushal, N. N.; Malaviya, B. K.; Gaertiner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Amer. Nucl. Soc.; 18: 311-312(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17322 MULTIREGION SPECTRA BY GENERALIZED CONTINUOUS SLOWING DOWN INTEGRAL TRANSPORT THEORY. Epstein, G.; Becker, M. (Rensselaer Polytechnic Inst., Troy, NY). Trans. Amer. Nucl. Soc.; 18: 316-317(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17323 APPLICABILITY OF THE DIFFUSION APPROXIMATION FOR STUDYING THE EXISTENCE OF DISCRETE EIGENVALUES OF THE BOLTZMANN EQUATION. Shamasundar, B. I.; Kallfelz, J. M. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 18: 318-319(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17324 DATA UNCERTAINTIES IN ENDF/B TESTING. Hutchins, B. A. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 18: 337(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17325 ESTIMATED UNCERTAINTIES IN EVALUATED DATA. Perey, F. G. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 337-338(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17326 CALCULATIONS OF RECENT PULSED SPHERE AND TANK INTEGRAL EXPERIMENTS WITH NITROGEN. Albert, T. E.; Straker, E. A. (Science Applications, Inc., Huntsville, AL). Trans. Amer. Nucl. Soc.; 18: 362-363(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17327 CROSS-SECTION SENSITIVITIES FOR SODIUM IN RELATION TO FAST REACTOR SHIELDING. Goldstein, H.; Huang, L. Y.; Ku, L. P.; Cacuci, D. (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 18: 364-365(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17328 MECHANISMS OF FAST-NEUTRON PENETRATION THROUGH THICK LAYERS OF SODIUM. Huang, L. Y.; Goldstein, H. (Columbia Univ., New York). Trans. Amer. Nucl. Soc.; 18: 365-366(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17329 NEUTRON SPECTRA EMITTED FROM CONCRETE SPHERES BOMBARDED WITH 14-MeV NEUTRONS. Hansen, L. F. (Lawrence Livermore Lab., Livermore, CA); Anderson, J. D.; Doyas, R. J.; Howerton, R. J.; Kammerdiener, J. L.; Komoto, T.; Logan, C. M.; Wong, C. Trans. Amer. Nucl. Soc.; 18: 380-381(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17330 REMOVAL-DIFFUSION THEORY VS TRANSPORT THEORY IN SHIELDING DESIGN SABINE–ANISN COMPARISON. West, J. T. III. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 18: 398-399(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17331 NEXT FLIGHT ESTIMATION FOR THE FICTITIOUS SCATTERING MONTE CARLO METHOD. Cramer, S. N. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 18: 400-401(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17332 DOPPLER EFFECT ON NEUTRON RESONANCE ABSORPTION IN THIN URANIUM METAL. Baughn, J. W. Stanford, CA; Stanford University (1973). 134p. University Microfilms Order No. 74-6449.

Thesis (Ph. D.).

The analytical formulation of the Doppler effect in ^{238}U was studied. Experiments were conducted which extend the temperature range of Doppler-effect measurements for thin foils of uranium metal. A comparison of two computer programs (ZUT-TUZ and TRIX) showed poor agreement for the calculated Doppler ratios of thin resonance absorbers. The source of this disparity was traced to the use in TRIX of the principle of equivalence. A temperature-dependent improved rational approximation to the escape probability was formulated which maintains the very useful principle of equivalence while improving the Doppler effect calculations. The TRIX program was modified and calculations were performed for both gold and uranium foils (using BNL-325 resonance parameters). The calculations for gold foils improved agreement between earlier measurements and the calculations. The modified TRIX showed good agreement with ZUT-TUZ for uranium foils and was used to generate a family of curves of the Doppler effect over a wide range of S/M and temperature for comparison to experiment. The activation technique for measuring Doppler effects in thin uranium metal samples in a thermal reactor was modified to remove the dependence on flux monitor foils, and the temperature range was extended to 1000°K. In these experiments two thin foils within a cadmium filter were activated with one foil at a reference temperature and the other heated. Measurements were made on uranium foils of 0.002-, 0.004-, and 0.005-inch thickness. The measurements compared well at 230°C with earlier measurements; however, the measured Doppler ratios were consistently higher than those predicted with the above calculations. The source of the difference between the experimental and calculated results is believed to originate in assumptions of the flat-flux model on which the calculations were based. (RWR)

17333 ANALYSIS OF TWO-DIMENSIONAL NEUTRON TRANSPORT PROBLEMS BY MEANS OF SINGULAR INTEGRAL EQUATIONS IN TWO COMPLEX VARIABLES. Sanchez, J. (Instituto Politecnico Nacional, Mexico City). Rev. Mex. Fis.; 22: No. 3, 231-255(1973).

The two-dimensional quarter-space problem of neutron transport theory is analyzed by means of the Fourier transformation. Two procedures for the approximate determination of the neutron density are developed, and their convergence is analyzed. Under the assumption that the two-dimensional dispersion function is factorized in a convenient manner, a closed-form solution is established. (7 figures) (auth)

17334 FAST NEUTRON SPECTRA AT THE SURFACE OF SPHERICAL SHELLS OF NATURAL URANIUM. Goddard, A. J. H. (Imperial Coll. of Science and Tech., London); Williams, J. G.; Lichtblau, H. Ann. Nucl. Sci. Eng.; 1: No. 2, 139-154(Feb 1974).

Energy spectra have been measured by the time of flight method, of fast neutrons leaking from the surface of spherical shells of natural uranium. Source neutrons were generated at the center of the shells by electron bombardment of spherical natural uranium and also lead targets. New measurements have been made of the neutron spectra generated by these targets in order to specify the source to be used in S_n transport theory calculations. Shell thicknesses of 9.9 cm and 3.0 cm were used. Spectra were measured at 22 and 45° to the shell surface normal and covered the energy range 10 keV to 6 MeV. The measurements were compared with S_n theory predictions. Results of an automatic data adjustment which made use of the measurements are also presented. (auth)

17335 EXACT SOLUTION OF THE CRITICAL PROBLEM OF A SLAB SURROUNDED BY TWO REFLECTORS WITH LINEAR ANISOTROPIC SCATTERING USING THE SPHERICAL HARMONICS METHOD. Winkler, H. Karlsruhe, Ger.; Karlsruhe Univ. (1971). 93p. (In German).

4 figs.; with tabs.; 27 refs. Available from the library of Karlsruhe Univ. Diss. (D. Sc.).

For the problem stated in the title, the criticality condition is deduced and an approximate solution as well as upper and lower limits for the critical slab thickness are given. The numerical results are discussed and compared with similar work by other authors. (GE)

Nuclear Properties and Reactions, A ≤ 5

17336 (LA-UR-74-738) MODELS BASED ON MULTICHANNEL R-MATRIX THEORY FOR EVALUATING LIGHT ELEMENT REACTIONS. Dodder, D. C.; Hale, G. M.; Nisley, R. A.; Witte, K.; Young, P. G. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 41p. (CONF-740320-3). Dep. NTIS $5.25.

From EANDC topical meeting; Tokyo, Japan (27 Mar 1974).

Multichannel R-matrix theory was used as a basis for models for analysis and evaluation of light nuclear systems. These models have the characteristic that data predictions can be made utilizing information derived from other reactions related to the one of primary interest. Several examples are given where such an approach is valid and appropriate. (18 figures) (auth)

17337 (TID-26604) TEST OF ISOSPIN CONSERVATION BY A COMPARISON OF THE REACTIONS $^3H(^3He, ^4He)^3H$ AND ^3He $(^3He, ^4He)2p$. Roberts, W. J. (Tennessee Univ., Knoxville (USA)). Mar 1973. 78p. Dep. NTIS $7.00.

Thesis.

The absolute differential cross sections for the reactions $^3H(^3He, ^4He)^3H$ and $^3He(^3He, ^4He)2p$ were measured at 16.0 MeV c.m. The cross section for leaving the di-proton in the $^1S_0$ state for the latter reaction was extracted by using final-state interaction theory. Conservation of isospin requires this cross section to have twice the magnitude and the same angular distribution as the former reaction. Isospin conservation also requires that the former reaction be symmetric about 90° c.m. At 16.0 MeV c.m. deviations from 90° symmetry were found for the former reaction which are consistent with lower-energy data. In addition, deviations from isospin conservation for the comparison test are reported. However, by using the same single-nucleon-transfer model used by Gross et al. (1972) to account for the deviations they observed, both the deviation from symmetry for the former reaction and the deviations from the factor of two for comparing the reactions could be explained qualitatively. (12 figures, 4 tables) (auth)

17338 DIFFERENCE BETWEEN POLARIZATION AND ANALYZING POWER IN THE REACTION $^3H(p,n)^3He$. Arnold, L. G. (Ohio State Univ., Columbus); Seyler, R. G.; Donoghue, T. R.; Brown, L.; Rohrer, U. Phys. Rev. Lett.; 32: No. 6, 310-313(11 Feb 1974).

The difference between polarization and analyzing power for the reaction $^3H(p,n)^3He$ is examined. It is found that this difference is due to the presence of $^3P_2 \rightarrow {}^3F_2$ transitions which are enhanced in the vicinity of the lowest 2^- state of ^4He. (auth)

17339 PHOTODISINTEGRATION OF ^3He AND SCHIFF WAVE FUNCTION. Erdas, F. (Univ., Cagliari, Italy); Pompei, A.; Quarati, P. Nuovo Cim.; 22A: No. 2, 324-330(21 Jul 1974).

By means of partial photonuclear sum rules, it was investigated whether the widely used ^3He wave function which comprises S, S' and D states (Schiff w.f.), given in terms of Gaussian functions, is capable of explaining the experimental equality $\sigma_{-1}(d,p) = \sigma_{-1}(p, pn)$. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 17336 and 17425.

17340 (COO-2231-16) NEUTRON SPECTRA AT 0° FROM 724-MeV PROTONS ON Be AND Cu. Madey, R.; Waterman, F. M. (Kent State Univ., Ohio (USA). Dept. of Physics). 1973. 15p. (CONF-731146-1). Dep. NTIS $4.00.

From meeting of the American Physical Society; Bloomington, New York, USA (3 Nov 1973).

Comparison of measured and predicted spectra from beryllium indicates that the intranuclear cascade model underestimates the neutron production both in the quasi-free peak and in the continuum between 300 MeV and the cut-off energy at 175 MeV. The position of the quasi-free peak was observed at the proton bombarding energy, in agreement with theory. The measured

spectrum from copper showed a substantial contribution in the continuum between 300 MeV and the cut-off energy at 175 MeV. In this continuum region, the measured spectrum from copper increases with decreasing energy, whereas the calculated spectrum decreases with decreasing energy. (RWR)

17341 (COO-3071-83) T = T_z + 2 GDR AND THE DIPOLE STATES OF THE A = 6 AND 14 NUCLEI. Vergados, J. D. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 28 Feb 1974. 40p. Dep. NTIS $5.00.

The isospin properties of the giant dipole resonance (GDR) built on states with isospin T = T_z + 1 are discussed. Results of a shell-model calculation with realistic interactions for dipole transitions to various low-lying states in ^{6}Li, ^{6}He, ^{14}N, and ^{14}C are presented. The T = T_z + 2 component of the GDR in ^{14}N decaying to the 0^+, T = 1 state is predicted at the surprisingly low energy E_x = 26.5 MeV. (2 figures, 4 tables) (auth)

17342 (EFI-29(73)) STUDY OF INCOHERENT PHOTOPRODUCTION OF MESONS ON NUCLEI. Abramyan, L. O.; Agan'yants, A. O.; Vartapetyan, G. A.; Lebedev, A. N.; Muradyan, E. G.; Khudaverdyan, A. G.; Khurshudyan, L. S. (Erevanskij Fizicheskij Inst. (USSR)). 1973. 29p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The results of the photoproduction of single $\pi^\pm$ = and π^0-mesons from complex nuclei Be, C, Al, Cu, Ag, Pb, at $E\gamma$ = 2; 3 GeV and $|t|$ = 0.3; 0.58(GeV/c)^2 and $E\gamma$ = 2 GeV and $/t/$ = 0,5 (GeV/c)^2 respectively are presented. On the basis of $\pi^\pm$ meson photoproduction data a model of the interaction of high energy photons with nuclei was proposed, which satisfactorily agreed with experimental data at $/t/ \simeq 0{,}5$(GeV/c)^2, $E\gamma$-dependence of Zeff, constant over the entire 2 to 16 GeV energy interval (see SLAC 8 to 16 GeV data) was investigated. The data contradict the VDM predictions; the difference between the proton and neutron density distributions on the surface of nucleus was estimated, which agreed with Be the estimate for Pb. The total ηN-interaction cross section as estimated from η^0-meson photoproduction data agreed with the additive quark model predictions. The charged π-mesons were detected by the magnetic spectrometer in 1.7 to 4 GeV/c momentum interval and the $\eta^0(\pi^0)$-mesons on the γ-spectrometer by their 2γ decay models. (auth)

17343 (JINR-P4-7874) PECULIARITIES IN THE BEHAVIOUR OF CHARGE FORM FACTORS OF ALPHA-CLUSTERING NUCLEI. Inopin, E. V.; Kinchakov, V. S.; Luk'yanov, V. K.; Pol, Yu. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

In the framework of the alpha-cluster projection model (the Brink model) the dependence of the charged form factors of ^{12}C and ^{24}Mg on the basic trial nucleon wave function parameters is investigated. An interpretation of the peculiarities of the form factor behavior of the alpha-clustering nuclei is made. The cluster-structural nature of their behavior at large momentum transfer q > 3 fm^{-1} is found. (auth)

17344 (RLO-1388-233) PRODUCTION OF Li AND B IN PROTON AND ALPHA-PARTICLE REACTIONS ON ^{14}N AT LOW ENERGIES. Jacobs, W. W.; Bodansky, D.; Chamberlin, D.; Oberg, D. L. (Washington Univ., Seattle (USA). Dept. of Physics). 1973. 32p. Dep. NTIS $4.75.

Cross sections were measured for the production of ^{7}Li and ^{11}B from the reactions ^{14}N(p,2α)^{7}Be and ^{14}N(p,α)^{11}C from near threshold to 24 and 22 MeV, respectively, and for the production of ^{6}Li and ^{10}B in α-particle bombardment of ^{14}N up to 42 MeV. The proton reactions were studied with activation techniques; and the α-particle reactions, investigated by using time-of-flight particle identification. These cross sections are of interest because of their relevance to the production of the light elements in nature by relatively low-energy particles. Analyses of comparative production cross sections from CNO targets indicate that it is possible to match the solar system abundances of LiBeB with reactions dominated by protons of energies below about 25 MeV, provided one accepts the higher of recent estimates of the B abundance. (7 figures) (auth)

17345 (RLO-1388-246) UPPER LIMIT ON THE RADIATIVE WIDTH OF THE 9.64-MeV STATE OF ^{12}C. Chamberlin, D.; Bodansky, D.; Jacobs, W. W.; Oberg, D. L. (Washington Univ., Seattle (USA). Dept. of Physics). 1974. 9p. Dep. NTIS $4.00.

An experimental upper limit for the branching ratio, Γ_{rad}/Γ, for electromagnetic transitions from the 9.64-MeV state of ^{12}C was established through a search for coincidences between inelastically scattered α particles and associated ^{12}C ions. It is concluded from the measurements that Γ_{rad} is probably less than 14 MeV. The upper limit at a 95% confidence level is Γ_{rad} = 28 MeV. (1 figure) (auth)

17346 R-MATRIX ANALYSIS OF THE n+^{10}B SYSTEM AT LOW ENERGIES. Hale, G. M.; Young, P. G.; Nisley, R. A. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 327-329(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17347 ABSOLUTE DETERMINATION OF THE ^{6}Li(n,α) CROSS SECTION AT 964 keV. Stephany, W. P.; Knoll, G. F. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc.; 18: 329(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17348 MEASUREMENT OF THERMAL-NEUTRON CROSS SECTIONS FOR POLYCRYSTALLINE MODERATORS. Shamasundar, B. I.; Kallfelz, J. M. (Georgia Inst. of Tech., Atlanta). Trans. Amer. Nucl. Soc.; 18: 333-334(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17349 TOTAL NEUTRON CROSS SECTIONS FOR 12 $\leq$ A $\leq$ 64 IN 15-MeV TO 25-GeV ENERGY RANGE. Sanna, R. S. (Atomic Energy Commission, New York). Trans. Amer. Nucl. Soc.; 18: 362(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17350 CARBON AND NITROGEN σ(n,xγ) MEASUREMENTS FROM THRESHOLD TO 20 MeV. Orphan, V. J.; Hoot, C. G.; Rogers, V. C.; Verbinski, V. V. (Intelcom Rad Tech, San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 363-364(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17351 R-MATRIX ANALYSIS OF THE ^{17}O SYSTEM; ENDF/B-IV. Hale, G. M.; Young, P. G.; Foster, D. G. Jr. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 366-367(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17352 WEAK MAGNETISM AND SECOND-CLASS CURRENT INTERACTIONS IN A = 8. Tribble, R. E.; Garvey, G. T. (Princeton Univ., NJ). Phys. Rev. Lett.; 32: No. 6, 314-317 (11 Feb 1974).

The β-α angular correlations in A = 8 in order to extract a value for the weak-magnetism element as part of a test of conservation of vector current. Possible contributions to the angular correlation from vector second-forbidden matrix elements and a second-class induced-tensor matrix element are shown to be small on the basis of experimental evidence and wave-function calculations. (auth)

17353 TYPICAL REALIZATION OF ALPHA-PARTICLE MODEL ASPECTS IN BERYLLIUM REGION. Hiura, J. (Iwate Univ., Morioka, Japan); Tamagaki, R. Progr. Theor. Phys. (Kyoto), Suppl.; No. 52, 25-88(Aug 1973).

The aspects of alpha-particle model in Be region are discussed. It is of particular importance to understand the reason why internally (intra-α) strong and externally (inter-α) weak binding is realized in this system. The origin of the correlation with the internally strong but externally weak character should be explained by starting with realistic nuclear forces and the Pauli principle. The special properties of the realistic nuclear forces, such as OPEP-tail, strong tensor force and weak odd-state central force, are responsible for the lack of long-range attraction in $\alpha-\alpha$ interaction. It is discussed that the main effect of strong nonlocal interaction can be represented by the orthogonality condition to the relative states forbidden by the Pauli principle. The connection between generator coordinate method and resonating group method is presented. The applicability of the α-particle model to ^{9}Be is discussed on the basis of the effective $\alpha-\alpha$ potential established in ^{8}Be and the weak binding property of neutron-α interaction by properly taking into account the essential effect of the Pauli principle in (α + α + n) structure. Another interesting feature found in this work is the coexistence of coupling schemes in many-body molecule-like configuration, namely, the explanation by the strong coupling scheme for negative parity states and possible interpretation by the weak coupling scheme for positive parity states. Finally, the di-cluster structure in the A = 7 system with α + ^{3}He(^{3}H) configuration is discussed in the logical extension of the consequences obtained for ^{8}Be. (Kato, T.)

17354 ENERGY SHIFTS OF GROUND-STATE ROTATIONAL BANDS IN ^{8}Be AND ^{9}Be. Bouten, M.; Bouten, M. C. (SCK-CEN, Mol, Belg.). Lett. Nuovo Cim.; 10: No. 4, 161-162(25 May 1974).

Projected Hartree–Fock calculations were carried out using the intrinsic Hamiltonian with the Volkov force and expanding the Hartree–Fock orbitals in a basis of five oscillator shells. The energies of the lowest level of each band studied are given both in the shell model and no deformation and in the projected Hartree–Fock calculation. The energy gain due to the deformation is shown. It is determined how the results depend on the nuclear deformation by repeating the calculation with a previous Bl-force. (JFP)

17355 $^{7}Li + d \rightarrow 2\alpha + n$ REACTION. II. Experimental Results at $E_d = 1.0$ MeV. D'Amico, V. (Univ., Messina, Italy); Fazio, G.; Jannelli, S.; Mezzanares, F.; Potenza, R. Nuovo Cim.; 22A: No. 2, 313-323(21 Jul 1974).

The $^{7}Li + d \rightarrow 2\alpha + n$ reaction was studied at $E_d = 1.0$ MeV, detecting the bidimensional spectra of the α-particles at various angles. The internal-energy spectra of the α-n systems formed in the final state and the angular correlations of the α-particles in the systems of the relative coordinates were extracted. The results seem to agree with the hypothesis that the α-n systems are polarized. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 17342, 17343, and 17349.

17356 (COO-3244-29) EXPERIMENTAL NUCLEAR PHYSICS. Annual Progress Report, June 1973–June 1974. Barnes, P. D. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). 1974. Contract AT(11-1)-3244. 20p. Dep. NTIS $4.00.

The Carnegie–Mellon University Users Group has concentrated on LAMPF projects and Σ^- atomic x-ray studies this year. The highlight of the latter effort has been a new and more precise measurement of the magnetic moment of the Σ^- hyperon. The result (-1.48 ± 0.37 nm) is in agreement with the sign given by simple SU(3) theory, but differs from the predicted value of -0.9 nm. The group's activities at LAMPF have been concentrated in three areas: Prototype intrinsic Ge particle spectrometer development and tests at the LEP and P^3 channels; Set up and execution of experiments #153/#158 on the External Proton Beam line; and Continued development and testing of the data acquisition system for EPICS. Extensive measurements with the intrinsic Ge charged particle spectrometer on the LEP, P^3 and External Proton Beams have both demonstrated its great promise and indicated some development work that needs to be done. An experiment to study multiple alpha particle emissions in high-energy proton-induced reactions has been set up and is now producing data on the EPB line. The EPICS data acquisition system is now largely operational in terms of data flow and control. It was tested extensively under actual experimental conditions. Computer programs were written and tested for theoretical analysis of the elastic and inelastic pion scattering data to be collected at EPICS and the LEP channel. (auth)

17357 ELECTROMAGNETIC RADIATION ACCOMPANYING K^- CAPTURE IN COPPER, NICKEL, SILICON, AND ALUMINUM. Redwine, R. P. Evanston, IL; Northwestern University (1973). 138p. University Microfilms Order No. 74-7805.

Thesis (Ph.D.).

The x-rays from kaonic atoms of copper and nickel were studied. Measurements with a planar lithium drifted germanium detector have shown strong interaction effects on the energy, width, and yield of the kaonic n = 5 to n = 4 transition in copper and nickel. The measured effects are consistent with results obtained by other researchers using other targets. A local optical potential is used to fit the copper and nickel data. The optical potential parameters obtained from this analysis are in reasonable agreement with parameters obtained using kaonic atom data from other targets. The optical potential parameters do not agree with those obtained using the free particle s-wave kaon-nucleon scattering lengths. The difficulties encountered in trying to use kaonic atom data to study the nuclear surface are discussed. Prompt nuclear γ-rays emitted by targets of copper, nickel, silicon, and aluminum following K^- capture were also studied. The γ-ray measurements were made with a coaxial lithium drifted germanium detector. Strong radiations were seen from the target nuclei in all cases. For the copper and nickel targets, prominent transitions were seen from even–even nuclei lighter than the target by up to about twelve nucleons. For both copper and nickel the total intensity of all of the identified nuclear γ-rays amounts to about twice that of the strongest x-ray. The observed nuclear γ-rays indicate that multiple alpha particle removal accompanies K^- capture by a nucleus. Shorter data runs were taken with the silicon and aluminum targets. For the lighter targets the fastest removal process appears to be single proton removal. A relatively large number of the lines from the silicon and aluminum targets remain unidentified. Similarities between the stopped kaon results and results from recent work with fast and stopped pions are discussed. (Diss. Abstr. Int., B)

17358 ELECTRON SCATTERING BY ^{26}Mg. Oyamada, M.; Terasawa, T.; Okazaki, Y.; Nakahara, K.; Sugawara, M. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 26-31(Dec 1972). (In Japanese).

A progress report concerning electron scattering by ^{26}Mg is described. A metallic target of ^{26}Mg enriched to 99.4% was used for experiment. The energy of incident electrons was 250 MeV, and angle of scattering was selected as 35, 50, 60, 70, and 80°. Crannell's method was applied for measurement. The form factor was obtained by dividing scattering cross section by the cross section of Mott scattering. The form factor at 1.81 MeV (2^+) and 2.94 MeV (2^+) levels showed that excitation was of E2 character. The reduced transition probability B(E2, $0 \rightarrow 1.81$) shows collective nature, whereas the probability B(E2, $0 \rightarrow 2.94$) suggests single particle excitation. The form factor at 5.29 and 6.88 MeV seems to be E3 excitation. Since levels of 4.32, 4.33, and 4.35 MeV were hardly separated, the form factor was obtained as a group. The form factor at 4.83, 4.90, and 4.97 MeV levels also was shown as a group. Characteristic features of both form factors are similar, and suggest inclusion of 4^+ level in the 4.9 MeV group. Large resonance peaks were seen in the spectrum of the electron scattering at 250 MeV. The peaks were observed at energy of 17 and 22 MeV. Experiment to make clear the nature of these peaks is in progress. (JA)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 15739, 16715, 17368, and 17374.

17359 (COO-3001-64) EXCITATION OF GIANT RESONANCES IN ELECTRON AND PROTON SCATTERING. Hammerstein, G. R.; McManus, H.; Moalem, A.; Kuo, T. T. S. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.; State Univ. of New York, Stony Brook (USA)). Feb 1974. Contract AT(11-1)-3001. 8p. (MSUCL-108). Dep. NTIS $4.00.

Microscopic-model calculations are presented for various multipole states in ^{48}Ca. A resonance-like structure largely due to dipole and quadrupole states is predicted in the giant dipole region with qualitatively the same features observed in electron and proton scattering. The calculated cross sections are in good agreement with those obtained from simple phenomenological collective models and the available scattering experimental data. (4 figures, 1 table) (auth)

17360 (ORNL-4937, pp 174-203) ELECTRON LINEAR ACCELERATOR (ORELA). May 1974.

In physics division annual progress report for period ending December 31, 1973.

The research program at ORELA is summarized, and then 16 individual papers are presented. Development of equipment and programs for neutron time-of-flight spectroscopy is described. Precise, high-resolution total cross section measurements can be made on light nuclei, as was done for ^{48}Ca. Studies were made of the energy of gamma rays from neutron capture in several resonances in ^{57}Fe. The emphasis of the capture cross-section program was on measurements of nuclides of interest in nucleo-synthesis. Subthreshold fission is a striking example of intermediate structure: properties of the first and second potential wells, such as barrier heights, differences between well depths, coupling between the states of the two wells, etc., were studied. Total cross section measurements have shown that there is now no evidence for an M1 giant resonance in ^{208}Pb; work on Zr isotopes was also reported. In addition to basic nuclear physics experiments, effort was also devoted to applied problems such as standard neutron cross sections. (RWR)

17361 SPHERICAL TO ASYMMETRIC SHAPE TRANSITION IN THE MASS REGION WITH $50 < (N,Z) < 82$. Habs, D. (Univ., Heidelberg); Klewe-Nebenius, H.; Wisshak, K.; Loehken, R.; Nowicki, G.; Rebel, H. Z. Phys.; 267: No. 2, 149-155(Mar 1974).

Collective potential energy surfaces were determined in the mass region with $50 < (N,Z) < 82$ by fitting experimental level spectra and B(E2)-values on the basis of the generalized collective model of Gneuss und Greiner. While the nuclides with N = 80 and with Z = 52 are rather soft vibrators an abrupt transition to asymmetric rotators for N = 78 and for Z = 54 was found tending to more symmetric shapes further away from the closed shells.

The results predict the position of levels not yet observed and B(E2)-values. (orig.) (GE)

17362 NUCLEON MEAN FREE PATH IN NUCLEAR MATTER. Gadioli, E. (Univ., Milan); Erba, E. G.; Sona, P. G. Lett. Nuovo Cim.; 10: No. 9, 373-378(29 Jun 1974).

The possibility is discussed that since in all the energy ranges considered the mean free path is comparable with the diameter of a heavy nucleus, the nuclei would not appear too transparent to incident nucleons. It is shown that the use of the mean free paths allows one to predict correct values for the nucleon absorption cross sections. The nuclei nickel-58, zirconium-90, tin-120, and bismuth-209 are considered. (JFP)

17363 STUDY OF $(\vec{d},p)$ REACTIONS ON ^{52}Cr, ^{54}Fe, AND ^{60}Zr WITH A TENSOR POLARIZED BEAM. Rohrig, N. D. Madison, WI; University of Wisconsin (1973). 242p. University Microfilms Order No. 74-32,141.

Thesis (Ph. D.).

Angular distributions of the three tensor analyzing powers were measured for $(\vec{d},p)$ reactions on ^{52}Cr, ^{54}Fe, and ^{90}Zr at $E_d = 10$ MeV. The angular range from 5 to 130° was covered in 5° steps for a total of 18 transitions with l = 0 to 4. The polarization of the tensor polarized deuteron beam from the Wisconsin Lamb-shift source was monitored with a tensor polarimeter employing the $^3He(\vec{d},p)^4He$ reaction. The design and calibration of the polarimeter are described along with a comprehensive discussion of the measurement techniques. The measured tensor analyzing powers are fairly large (~0.2) and show considerable structure. For the l = 1 transitions, transitions spanning a large range of reaction Q-value were studied. The dependence of the tensor analyzing powers on Q-value is considerable and has different characteristics for the $j = 1/2$ and $j = 3/2$ transitions. The tensor analyzing powers do not show clear j-dependent features like the well-known j-dependence of the vector analyzing powers. However, the sign of T_{22} at forward angles does seem to depend on j. Distorted-wave Born approximation (DWBA) calculations are presented with the data. The optical potentials used in the DWBA calculations contain vector spin-orbit terms and result from fits to elastic scattering cross section and vector analyzing power data. Tensor spin dependent potentials are not included. Most of the calculation neglect the deuteron D-state. If the D-state is neglected, the calculated T_{21} analyzing powers are too small by an order of magnitude, and the other analyzing powers are poorly described, but the same calculations describe the measured vector analyzing powers and differential cross sections quite nicely. A few calculations were done including the deuteron D-state, and these calculations fit the tensor analyzing power data at forward angles markedly well. (Diss. Abstr. Int., B)

17364 POLARIZATION STUDY FOR ISOBARIC ANALOG RESONANCES IN $^{62}Ni(p,p)^{62}Ni$. Takasaki, E. (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys.; 34: No. 2, 151-160(Feb 1973).

Polarization excitation functions of protons elastically scattered from ^{62}Ni at a laboratory angle of 50° have been measured in the energies between 2.43 and 2.75 MeV by using the double-scattering techniques. Differential cross sections also have been measured at the laboratory angles of 140° and partly 160°. Four analog resonances, corresponding to the ground state, and the first, the second, and the third excited states in the parent nucleus of ^{63}Ni, were observed. The spins of $p_{1/2}$, $f_{5/2}$, $p_{3/2}$, and $p_{1/2}$ were assigned to these states, respectively. (auth)

17365 ENERGY LEVELS OF ^{40}Ca STUDIED BY THE $^{39}K(p,\alpha_0)^{36}Ar$ REACTION. Nakashima, T. (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap.; 36: No. 1, 10-17(Jan 1974).

Resonances in the $^{39}K(p,\alpha_0)^{36}Ar$ reaction were investigated. In the energy region $E_p = 3.05 - 4.20$ MeV, 102 resonances were observed. Resonance energies, strengths and widths are reported. The angular distributions were measured at 37 resonance energies, and the analysis by the one-level formula allowed unique assignment of the spins for 17 cases. In 18 cases, two or more different spin assignments were possible. An experimental level density of ^{40}Ca was estimated to be $\rho_{exp} = 131$ MeV^{-1} at the excitation energy $E_x = 11.87$ MeV. By the smoothing procedure of the excitation function, a broad resonance with the width of about 400 keV was obtained at $E_p = 3.45$ MeV. An average alpha-particle reduced width in this reaction was estimated to be about $0.02 \times \hbar^2/MR^2$. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 15739, 17340, 17342, 17349, 17357, 17361, and 17382.

17366 (ANL-Trans-954) DEVELOPMENT OF MOESSBAUER SPECTROSCOPY WITH THE USE OF ^{67}Zn. Beskrovny, A. I.; Lebedev, N. A.; Ostanevich, Yu. M. (CONF-710947-5). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1971. Translation of JINR-P14-5958. 20p. Dep. NTIS $4.00.

The Moessbauer effect in ^{67}Zn was studied by use of the γ-ray detector current integration technique in transmission geometry. The relative value of the resonance effect without background corrections was 1.3×10^{-3}, the line width was $(0.6-1.0) \times 10^{-4}$ cm/s. The quadrupole splitting parameters of the 92.7-keV transition in ZnO measured with ZnO(^{67}Ga) source were found to be $|e^2qQ| = 2.32 \pm 0.11$ MHz, $\eta = 0.19 \pm 0.04$. From observation of velocity spectrum with single line source MgO(^{67}Ga), it was found that $e^2qQ_{ZnO} > 0$. In the last case the isomer shift was $(-21 \pm 2) \times 10^{-4}$ cm/s. The temperature red shift of Moessbauer line in ZnO in the range 4.2 to 43°K follows the equation $\delta\nu/\nu = -\alpha(T_A^4 - T_S^4)$ with $\alpha = 0.14 \times 10^{-20}$ (K)$^{-4}$. (8 figures) (auth)

17367 (COO-3069-200) INVESTIGATION OF ^{67}Zn STATES BY THE $^{66}Zn(d,p)$ AND $^{65}Cu(^3He,p)$ REACTIONS. Ismail, H. A.; Moore, W. H.; Hallock, J. N.; Enge, H. A. (Massachusetts Inst. of Tech., Cambridge (USA)). [nd]. Contract AT(11-1)-3069. 9p. (DSR-77904). Dep. NTIS $4.00.

The $^{66}Zn(d,p)^{67}Zn$ and $^{65}Cu(^3He,p)^{67}Zn$ reactions have been studied at bombarding energies of 7.5 MeV and 13.0 MeV, respectively. Below $E_x = 3.78$ MeV, 44 levels were observed in the (d,p) reaction, while 25 levels below $E_x = 5.21$ were observed in the (^3He,p) reaction. (3 tables) (auth)

17368 (LYCEN-7347) DE-EXCITATION BY STATISTICAL PRE-EQUILIBRIUM α EMISSION. Chevarier, N. (Lyon-1 Univ., 69 – Villeurbanne (France). Inst. de Physique Nucleaire). Jul 1973. 102p. (In French). Dep. NTIS (U. S. Sales Only) $8.25.

Thesis.

The α emission occurring from intermediate nuclei brought to the same excitation energy by different means was studied. In this way, the de-excitation of ^{60}Ni, ^{67}Ga, ^{118}Sb, and ^{210}Po nuclei was studied in (p,α), (^3He,α) and (α,α′) reactions. The analysis of pre-equilibrium α cross sections was not included in the models proposed. Components characteristic of two reaction mechanisms can be distinguished in the energy spectra of the emitted α particles: a low energy component corresponding to a statistical evaporation; a high energy component (attributed to a pre-equilibrium statistical emission) leading to angular distributions pointing strongly in the forward direction and to cross sections varying very little with the mass number of the target nucleus. The pre-equilibrium model in which the incident excitation energy is shared between a restricted number of degrees of freedom (excitons) is extended to the case of α emission. The problem was approached in two different ways: a hybrid model approximation; exciton model approximation. These models differ from one another by the way in which the lifetimes of the intermediate states are defined and expressed. The cross sections measured are interpreted in terms of both models. The shapes of the energy spectra and the absolute values of the cross sections measured are interpreted for the reactions by considering the α particle as an exciton. The average value determined for the α preformation factor is between 0.1 and 0.2, a result which is in good agreement with values found in the literature. (FR)

17369 EXCITATION FUNCTIONS FOR (p,n) REACTIONS ON ^{79}Br AND ^{127}I. Colle, R.; Kishore, R. (Brookhaven National Lab., Upton, NY). Phys. Rev., C; 9: No. 6, 2166-2170(Jun 1974).

Excitation functions for the $^{79}Br(p,n)^{79}Kr$ and $^{127}I(p,n)^{127}Xe$ reactions were determined from 3 to 25 MeV by the activation method. KBr and KI targets of natural isotopic abundances were encapsulated in Mylar to prevent escape of the gaseous ^{79}Kr and ^{127}Xe. Disintegration rates were obtained by assaying selected γ rays with calibrated Ge(Li) detectors; beam intensities were determined with a Faraday cup. The measured absolute cross sections have uncertainties of less than 10% with energy uncertainties of ≲100 keV. The excitation functions are compared to Monte Carlo calculations based on an intranuclear-cascade statistical-evaporation model. (auth)

17370 COBALT FAST-NEUTRON CROSS SECTIONS. Guenther, P. T.; Moldauer, P. A.; Smith, A. B.; Whalen, J. F. (Argonne National Lab., IL). Nucl. Sci. Eng.; 54: No. 3, 273-285 (Jul 1974).

Elastic and inelastic neutron scattering cross sections of cobalt were measured from incident energies of 1.8 to 4.0 MeV including the excitation of states at 1.10 ± 0.01, 1.20 ± 0.01, 1.30 ± 0.01, 1.43 ± 0.01, 1.46 ± 0.02, 1.72 ± 0.02, 2.06 ± 0.02, 2.09 ± 0.02, 2.16 ± 0.03, 2.35 ± 0.05, and 2.50 ± 0.05 MeV. Total neutron cross sections were measured from 2.0 to 4.5 MeV. The experimental results and previously reported values are used to deduce an

optical-statistical model which is descriptive of measured values to ~20.0 MeV. The observed inelastic scattering cross sections are related to the level structure of the target isotope, and are shown consistent with a nuclear structure model based upon a proton hole in the $f_{\frac{7}{2}}$ shell strongly coupled to a spherical core. A resolution to the previous ambiguities in J^{π} assignments is suggested. The experimental and calculational results are compared with the cross-section values given by ENDF/B-III. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 16711–16713, 16731, 16732, 17025, 17105, 17114, 17115, 17362, 17368, and 17369.

17371 (CONF-730804-P3, pp 1971-1976) STUDY OF NUCLEAR INTERACTION OF MUONS WITH ENERGY HIGHER THAN A FEW HUNDRED GeV. Chin, S.; Higashi, S.; Mioni, S.; Ozaki, S.; Takahashi, T. (Osaka Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A large calorimeter having the volume of 2m × 2m × 4.5m has been constructed in the vertical direction at the depth of 40 mwe underground to study the muon-nuclear interactions of a few hundred GeV. Within the running time of 2.5×10^7 sec, 1882 events of electromagnetic cascade and 95 events of nuclear interaction were detected. The equation of $I(E_\gamma) = 2.0 \times E_\gamma^{-3.0}$ is found to express the differential spectrum in the case of muon-nuclear interaction, assuming $L' = 0$, $L = 4\pi/\nu\ \sigma_{h\nu}\ (\Lambda^2/q^2 + \Lambda^2)$ and $\sigma_{h\nu} = 1.25 \times 10^{-28}$ cm^2/nucleon. B_n-value has been computed as 0.46×10^{-6} (g/cm^2)$^{-1}$ from these results. (auth)

17372 (CONF-730804-P3, pp 2167-2171) PROPERTIES OF A PERSISTING NUCLEON IN NUCLEON–NUCLEUS REACTIONS. Aganina, M. U.; Anoshin, A. I.; Bashindzhagyan, G. L.; Belzer, L. I.; Demianov, A. I.; Murzin, V. S.; Sarycheva, L. I.; Sinyov, N. B. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A new method of analysis of the ionization calorimeter data made it possible to distinguish nuclear cascades created by a process of successive interactions, wherein an incident nucleon transfers each time only a fraction of its energy to the secondary pions. The shape of the persisting nucleon spectrum, when compared to that, obtained at accelerators, testifies to so called "scaling" of structural function in a broad energy range from 24 GeV (accelerators) to some 300 GeV (cosmic rays). (auth)

17373 (CONF-730804-P3, pp 2179-2184) MEASUREMENT OF THE FRAGMENTATION CROSS SECTION OF 2.1 GeV/N ^{12}C AND ^{16}O IONS IN CsI AND TUNGSTEN. Cheshire, D. L. (Louisiana State Univ., Baton Rouge); Huggett, R. W.; Jones, W. V.; Roundtree, S. P.; Verma, S. D. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

A tungsten-scintillator ionization spectrometer (1000 g/cm^2 total depth) has been exposed to 2.1 GeV/nucleon ^{12}C and ^{16}O ions at the Bevatron. The apparatus included a five-layer CsI target (each layer 9 g/cm^2 thick). Fragmentations of the incident ions could be observed in the five layers of the CsI target and in five "high resolution" layers (each 13 g/cm^2 thick) of tungsten and scintillator. The number of fragmentations occurring in each of these layers was used to determine the total fragmentation cross sections and the Bradt-Peters overlap parameters for the incident beam particles in CsI and tungsten. (auth)

17374 (CONF-730804-P3, pp 2186-2190) HADRON INTERACTIONS WITH NUCLEI. Vishwanath, P. R. (Univ. of Michigan, Ann Arbor); Bussian, A. E.; DeMeester, G. D. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

After initial studies of hadron-proton interactions in the Echo Lake Cosmic Ray Project, hadron-nucleus interactions have been pursued by replacing the liquid hydrogen target with targets of heavier elements. The elements used were aluminum, iron, tin, and lead. An attempt was made to study the inclusive properties of the interaction as functions of atomic weight and energy. In particular, the angular distributions, multiplicity distributions, and average multiplicity are reported. The predictions of different high energy interaction models are also examined in connection with these results. The data contain about 200 events from each heavy element target at energies above 100 GeV. (auth)

17375 (CONF-730804-P3, pp 2191-2196) EFFECTIVE CROSS-SECTIONS FOR INELASTIC COLLISIONS OF HADRONS WITH ATOMIC NUCLEI OF AIR AND LEAD. Chubenko, A. P.; Ershova, T. A.; Nam, R. A.; Nicolskii, S. I.; Pavliutchenko, V. P.; Stamenov, Y. N.; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 3.

Effective cross section for inelastic hadron interactions with atomic nuclei of lead and air were investigated at energy range 10^{12}–10^{13} eV. The value of cross-section of hadrons-nuclei of lead is approximately constantly and $\sigma \sim 1800$ mb. Effective cross section of protons-nuclei of air atoms increases comparison to accelerator date by 20–25% at energy 2.10^{13} ev. (auth)

17376 (CONF-740637-4) HEAVY-ION-INDUCED FISSION. Plasil, F. (Oak Ridge National Lab., Tenn. (USA)). 1974. 27p. Dep. NTIS $4.50.

From international conference on reactions between complex nuclei; Nashville, Tennessee, USA (10 Jun 1974).

A review of heavy-ion fission is presented. After some general introductory remarks, the theoretical basis for the lowering of fission barriers with increasing angular momentum is reviewed. Theoretical studies making use of barrier calculations to describe fission competition in the de-excitation of compound nuclei are described, and some comparisons with experimental results are made. Then fission excitation functions for relatively light compound systems ranging from ^{181}Re to ^{137}La are discussed. The extent to which the excitation functions can be described theoretically is examined. Fission-fragment kinetic energies and mass distributions in heavy-ion fission are considered. Finally, experimental results relating to noncompound-nucleus and "quasi" fission are examined. (19 figures, 3 tables, and 47 references) (RWR)

17377 (ORNL-4937) PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1973. (Oak Ridge National Lab., Tenn. (USA)). May 1974. Contract W-7405-eng-26. 307p. Dep. NTIS $7.60.

This report is divided into thirteen sections, with the following titles: cyclotron laboratory research program, Van de Graaff laboratory, electron linear accelerator (ORELA), theoretical physics, status report of the Nuclear Data Project, high-energy activities, electron spectroscopy program, hyperfine interactions in solids, molecular spectroscopy, high-resolution electron microscopy program, publications, papers presented at scientific and technical meetings, and Omniana. The first four sections constitute over 75% of the report, and are subdivided into many brief contributions; separate abstracts were prepared for these four. (RWR)

For abstracts of individual sections see: 17360, 17378, 17382, and 17412.

17378 (ORNL-4937, pp 1-107) CYCLOTRON LABORATORY RESEARCH PROGRAM. May 1974.

In Physics Division annual progress report for period ending December 31, 1973.

The research program at the Oak Ridge Isochronous Cyclotron (ORIC) is summarized, and then 44 brief individual papers are presented. Although the program is increasingly dominated by heavy-ion research, light-ion work is still done, such as the use of 60-MeV polarized-proton beams to study the collective nature of giant resonances at high excitation. The heavy-ion research covered the gamut from atomic x-ray yields to nuclear physics and chemistry, and included the unique identification of element 104 by an x-ray–alpha-particle coincidence measurement. In the field of high-spin states in rotational bands, a new "backbending" rotational band in ^{170}W was found. The discovery of two decoupled bands in ^{165}Yb, one which backbends and one which does not, is also reported, along with the possible coexistence of a spherical and a deformed band in ^{188}Hg. The lifetimes of states up to the 10^+ member were measured in ^{154}Sm and ^{232}Th. Excitation functions were measured for the 4^+ members of rotational bands excited by two-proton transfer or two-neutron pickup by a ^{20}Ne beam incident on targets of ^{160}Gd, ^{162}Dy, and ^{154}Sm. Heavy-ion experiments in fission and fusion were also conducted. An upper limit for the Coulomb excitation cross section of the ^{239}Pu fission isomer by ^{20}Ne was established, and the fission products resulting from the compound system formed by ^{20}Ne bombardment of ^{107}Ag were measured. It was inferred that the ^{127}La* compound system could not be formed with an angular momentum of more than about 52ħ. Progress was made in the understanding of the ion–ion optical potential. The interference between Coulomb and nuclear excitation of collective nuclear states was used to probe the nuclear potential near the nuclear surface for the ^{11}B + ^{208}Pb and ^{22}Ne + ^{89}Sr systems. Resonance-like structure observed in the

lower-energy excitation function for $^{16}O + ^{16}O$ was found to continue to higher energies. In conclusion, the cyclotron development program, including a new ion source with a rotating cathode, is described. (RWR)

17379 FBCS MODEL AND THE INVERSE GAP EQUATIONS APPLIED TO THE TIN ISOTOPES. van Gunsteren, W. F. (Univ., Amsterdam); Boeker, E.; Allaart, K. Z. Phys.; 267: No. 2, 87-96(Mar 1974).

The FBCS model for odd nuclei and the inverse gap equations are applied to a whole sequence of tin isotopes, viz. $^{111-125}Sn$. From spectroscopic data on the odd isotopes, the single-particle energies and interaction strengths are obtained. With these parameters the lowest states of the even isotopes are calculated by a number-projected two-quasi-particle diagonalization and by the usual BCS one. This is done with two Gaussian interactions and the SDI. In the case of the Gaussian forces the experimental energies are well reproduced by the number-projected treatment. Effective charges for E-lambda transitions, which are required to reproduce the experimental transition rates, are rather constant for the whole series of isotopes, in case of the number-projected treatment. In addition, a number of spectroscopic factors for one-nucleon transfer reactions are calculated and good agreement with experiments is observed. (GE)

17380 HALF-LIVES OF TIN AND ANTIMONY FISSION PRODUCTS WITH A = 128 TO 133. Fowler, M. M.; Goth, G. W.; Lin, C.-C.; Wahl, A. C. (Washington Univ., St. Louis). J. Inorg. Nucl. Chem.; 36: No. 6, 1191-1198(Jun 1974).

The following half-life values have been determined: ^{128}Sb isomers, 10.00 ± 0.05 min and 9.10 ± 0.03 hr; ^{129}Sn isomers, 2.5 ± 0.3 min and 7.3 ± 0.2 min; ^{129}Sb, 4.41 ± 0.01 hr; ^{130}Sn, 3.7 ± 0.3 min; ^{130}Sb isomers, 6.33 ± 0.12 min and 40.9 ± 0.5 min; ^{131}Sn, 1.08 ± 0.10 min; ^{132}Sb, 3.4 ± 0.1 min; ^{133}Sb, 2.7 ± 0.1 min. Comparison of these and previously published values led to the following recommended values: ^{128}Sn, 59.3 ± 0.5 min; ^{128}Sb isomers, 10.0 ± 0.1 min and 9.1 ± 0.1 hr; ^{129}Sn isomers, 2.5 ± 0.2 and 7.4 ± 0.3 min; ^{129}Sb, 4.41 ± 0.05 hr; ^{130}Sn isomers, 3.7 ± 0.2 min and ~1.6 min; ^{130}Sb isomers, 6.3 ± 0.2 min and 40 ± 1 min; ^{131}Sn, 1.05 ± 0.10 min; ^{131}Sb, 23.0 ± 0.2 min; ^{132}Sn, 40 ± 1 sec; ^{133}Sn, ~2 sec; ^{133}Sb, 2.6 ± 0.1 min. It has also been determined that 14 ± 3% of 3.7-min ^{130}Sn decays to the 40-min ^{130}Sb isomer and that the fractional cumulative yield of 1.05-min ^{131}Sn is 0.33 ± 0.06 from thermal-neutron-induced fission of ^{235}U. (auth)

17381 STUDY OF NUCLEI BY ELECTRON SCATTERING. Torizuka, Y.; Kojima, Y.; Saito, T.; Ito, K.; Nakada, A. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 5: No. 2, 1-25(Dec 1972). (In Japanese).

Giant resonance in ^{90}Zr and ^{208}Pb other than electric dipole giant resonance is described. A large amount of resonance was observed at the excitation energy of 14 MeV in the electron scattering by ^{90}Zr. Analysis of experimental results was performed by assuming a form, $(d\sigma/d\Omega dE)$ quasi-elact. $= a(Ex-Eo)^{1/n}$ for quasi-elastic scattering. A Lorentz type was assumed for E1 and 14 MeV resonances, and x^2 fitting was applied. Level width $\Gamma\downarrow$ of the 14 MeV resonance was (4.8 ± 0.6) MeV. Multipolarity of the resonance level was investigated by DWBA method. The 14 MeV resonance seems to be E2 or E0, and of collective character. Three exciting levels were observed in the electron scattering experiment of ^{106}Pd. The levels are at the energy of 0.51, 2.09, and 2.7 MeV. A weak exciting level was seen at about 1.1 MeV. The form factor of the 1.13 MeV (2^+) level was explained by assuming the anharmonic vibrator model of mixing one phonon state and two phonon state, and the quadrupole moment obtained from the form factor was in good agreement with the result obtained by the experiment of reorientation effect. Experiment was carried out to study the resonance level in ^{208}Pb other than the E1 resonance. Three levels at 10.1, 10.5, and 11.2 MeV seem to be of E2 character. (Kato, T.)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 17368, 17376, 17378, and 17384.

17382 (ORNL-4937, pp 108-173) VAN DE GRAAFF LABORATORY. May 1974.

In Physics Division annual progress report for period ending December 31, 1973.

The research program at the ORNL van de Graaff laboratory is summarized, and then 43 individual papers are presented. Two isotopes of O were used for 60% of the operating hours of the tandem; protons, less than 2%. Atomic collisions physics and nuclear physics were in the ratio of 35:65 for research time. A large amount of time was used for installation of a new ion source system. The 5.5-MV van de Graaff was used principally for radiation damage simulation studies. A question concerning the role of conduction electrons in shielding a fast oxygen ion by a process called dynamic screening (and thus affecting the stopping power of the ion) was resolved. Additional evidence was found that the behavior of ionic stopping powers in the "velocity-proportional" region does not follow theoretical predictions. Relevant experimental data on the production of new neutron-deficient nuclei by heavy-ion reactions were obtained by two techniques. The results suggest that present calculations must be reviewed skeptically in their predictions of exceedingly small cross sections for production of nuclei far from the valley of stability. Because heavy-ion projectiles carry large amounts of angular momentum into nuclear reactions, high-spin states inaccessible in light-ion reactions can be selectively populated. This fact was demonstrated in a study of ^{42}Ca, where new states having spins from 5 to 9 were observed. The coexistence of spherical and deformed shapes in ^{72}Se with the $0^{+\prime}$ state as the head of the rotational band and with the two bands crossing near the 2^+ state was reported. In-beam gamma rays from ^{64}Zn produced by the $^{51}V(^{16}O,p2n)$ reaction showed two cascades of comparable intensity which have only weak transitions between the two and yet which are both fed via decay of a state at 4636 keV. High-spin states preferentially populated through heavy-ion reactions were explored through charged-particle studies using the Enge magnet. Coulomb excitation was used in studies of the even-mass $^{176,178,180}Hf$ and $^{156,158}Gd$ nuclei, transition probabilities for exciting 3^- states in actinide nuclei, and destructive interference between Coulomb and nuclear interactions. (RWR)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 17342, 17360, 17362, 17368, 17374-17376, 17381, and 17430.

17383 (ORNL-4909) ^{206}Pb, ^{207}Pb, AND ^{208}Pb NEUTRON ELASTIC AND INELASTIC SCATTERING CROSS SECTIONS FROM 5.50 TO 8.50 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 48p. Dep. NTIS $5.45.

Measured neutron ^{206}Pb differential elastic scattering cross sections at 5.50, 7.00, and 8.50 MeV are given and compared with previous results. Measured ^{206}Pb, ^{207}Pb, and ^{208}Pb neutron inelastic scattering cross sections are given at roughly 0.5 MeV intervals from 5.50 to 8.50 MeV and also compared with previous results. ENDF/B III MAT 1136 elastic angular distributions, angle-integrated elastic and inelastic scattering cross sections, and nuclear temperatures are in generally good agreement with experiment over this energy range. (19 figures, 94 tables) (auth)

17384 (ORO-2434-10) EXPERIMENTAL STUDY OF NUCLEAR MODELS. I. Decay Schemes and Nuclear Reactions. II. Muonic X-Ray Studies. Progress Report, August 1, 1973-September 30, 1974. Sheline, R. K. (Florida State Univ., Tallahassee (USA)). 1974. Contract AT(40-1)-2434. 159p. Dep. NTIS $11.00.

Research progress on Contract AT-(40-1)-2434 is summarized for the 14 months beginning August 1, 1973, and ending September 30, 1974. The main thrust of the research involves an experimental study of nuclear models. During the last contract year, considerable progress was made in the study of the level structures of ^{210}Bi and ^{209}Bi under the assumption of proton-neutron coupling and a simple shell-model interpretation for ^{210}Bi and weak coupling of the proton hole to the ^{210}Bi core in the case of ^{209}Bi. A sequence of odd-A neutron deficient La isotopes was also studied. These nuclei are normally thought to lie in the transition region between deformed and spherical nuclei. A decoupled band was observed which proves that at least this sequence of states in these La nuclei involves a considerable prolate deformation ($\beta \simeq 0.2$). Among the deformed nuclei studied are ^{175}Hf, ^{182}W, ^{184}W, and ^{187}Os. All four of these nuclei were analyzed by utilizing the Nilsson model. Theoretical research involved the study of backbending in nuclei, the use of the generator-coordinate method to study decoupled bands, a description of the potential energy surface for the neutron-deficient Ba nuclei, and the application of the generator-coordinate method to the pairing vibration. Molecular spectra of isotopically substituted metal carbonyls is described briefly. Finally, experimental progress during the last contract year for the study of muonic x-rays at LAMPF in collaboration with LASL is presented. A first paper in this area, a theoretical paper involving the effects of gamma instability on the muonic x-rays of ^{192}Os, is described. (auth)

17385 THREE-PARTICLE CORRELATIONS FROM ^{208}Pb + ^{6}Li. Ost, R.; Bethge, K.; Gemmeke, H.; Lassen, L.; Scholz, D. (Univ., Heidelberg). Z. Phys.; 266: No. 5, 369-371(Feb 1974).

Three-particle correlations in the reaction ^{208}Pb + ^{6}Li were studied near the Coulomb threshold between $E_{(^6Li)}$ = 24 and 30 MeV. Three reaction mechanisms contribute predominantly to the observed coincidences of the charged particles: Coulomb excitation of the 2,184 MeV, J = 3$^+$ state of ^{6}Li, followed by the decay into α + d. Deuteron pick-up of the ^{6}Li to the ground state of ^{8}Be and sequential decay into two α-particles and neutron-transfer to the ground state and the first excited states of ^{209}Pb : ^{208}Pb(^{6}Li,αp). The last two reaction mechanisms explain the previously measured large contributions to the α-channel relative to the d-channel. (orig.) (GE)

17386 EVIDENCE FOR A COLLECTIVE E2 RESONANCE IN THE REACTION ^{208}Pb(p,γ)^{209}Bi. Snover, K. A. (Univ. of Washington, Seattle); Ebisawa, K.; Brown, D. R.; Paul, P. Phys. Rev. Lett.; 32: No. 6, 317-320(11 Feb 1974).

An E2 or M1 resonance is observed in the reaction ^{208}Pb(p,$\gamma_0\gamma_1\gamma_2$) ^{209}Bi at $E_p \simeq 20.0$ MeV ($E_x \simeq 23.7$ MeV) with a width $\Gamma \sim 3.5$ MeV. Present evidence supports its identification as a collective E2 excitation. (auth)

17387 RADIATIVE PROTON CAPTURE CROSS SECTIONS IN ^{209}Bi WITH E_p FROM 10 TO 50 MeV. Miyano, K. (Niigata Univ., Japan); Nakahara, H. J. Phys. Soc. Jap.; 35: No. 5, 1277-1279 (Nov 1973).

The radiative proton capture cross sections in ^{209}Bi were measured with E_p from 10 to 50 MeV by applying a stacked foil technique. It was found that the excitation function has a maximum value of 0.38 mb at E_p = 12 MeV and then it becomes monotonously smaller as the bombarding energy increases up to E_p = 50 MeV. In the peak region of the excitation function, the magnitude of the cross sections is found to be a few times larger than that predicted by the statistical model. (auth)

17388 SEARCH FOR ISOBARIC ANALOGS OF ^{209}Tl AS RESONANCES IN THE ISOSPIN ^{208}Pb(n,p)^{208}Tl REACTION. Long, D. D.; Onega, R. J.; Lee, S. T. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Can. J. Phys.; 52: No. 7, 599-603(1 Apr 1974).

A search was made for isobaric analogs of levels in ^{209}Tl via the ^{208}Pb(n,p)^{208}Tl reaction, which is isospin forbidden in the entrance channel. No evidence is found for the existence of such resonances in ^{209}Pb. (auth)

17389 INELASTIC SCATTERING OF 40-MeV α PARTICLES BY ^{208}Pb AT SMALL ANGLES. Gregoire, G.; Lega, J.; Renuart, J. (Univ., Louvain, Belg.). J. Phys. (Paris); 35: No. 2, L11-L13(Feb 1974). (In French).

Cross sections for inelastic scattering of 40 MeV alpha particles by ^{208}Pb were measured between 8° and 20° (lab) for the 3$^-$ level (E = 2.615 MeV) and between 8° and 25° (lab) for the 5$^-$ level (E = 3.198 MeV). A collective model including Coulomb excitation is unable to reproduce the results obtained. (FR)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 17332, 17360, and 17376.

17390 (LA-5553-MS) ESTIMATED VALUES OF FRACTIONAL YIELDS FROM LOW-ENERGY FISSION AND A COMPILATION OF MEASURED FRACTIONAL YIELDS. Wolfsberg, K. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 173p. Dep. NTIS $7.60.

This report presents tables of estimated fractional fission yields. The yields are calculated from postulated Z_p functions and Gaussian charge dispersion curves. Odd–even Z factors are applied. Estimated yields are compared with measured values. (auth)

17391 (NEDO-12154-1) COMPILATION OF FISSION PRODUCT YIELDS, VALLECITOS NUCLEAR CENTER, 1974. Meek, M. E.; Rider, B. F. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center). 26 Jan 1974. 177p. (74-NED-6).

A compilation of 12,400 fission yield measurements reported in the open literature and calculated charge distributions was utilized to produce a recommended set of yields for the known fission products. The original data with reference sources as well as the recommended yields are presented in tabular form for the fissionable nuclides ^{235}U, ^{239}Pu, ^{241}Pu, and ^{233}U at thermal neutron energies; for ^{235}U, ^{238}U, ^{239}Pu, and ^{232}Th at fission spectrum energies; and for ^{235}U and ^{238}U at 14 MeV. (auth)

17392 (RLO-2225-T-31-2) DELAYED NEUTRON SPECTRA FROM FAST FISSION. Progress Report. Woodruff, G. L.; Sloan, W. R.; Eccleston, G. W. (Washington Univ., Seattle (USA). Dept. of Nuclear Engineering). May 1974. Contract AT(45-1)-2225. 85p. Dep. NTIS $7.50.

This report is a review of progress in the measurement of the energy spectra of delayed neutrons from fast-neutron-induced fission of ^{232}Th, ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu. During the past contract year progress was made in the following areas: A target irradiation system was designed and constructed at the University of Washington cyclotron. Preliminary measurements of beam current and cycling transients were completed. Modifications in electronic hardware designed to improve resolution and dynamic range were made. An extensive set of computer software was developed to permit computer-controlled irradiation cycles, data collection, and preliminary data processing. A study was completed to determine the optimal set of irradiation cycles in order to obtain the greatest possible information relative to delayed-neutron precursor identification. In order to achieve the objectives of the project some additional hardware and software development is still required. In addition to the spectrum measurements additional experiments are proposed in order to reduce uncertainties in the results. (auth)

17393 THERMAL DATA FOR FISSILE NUCLEI IN ENDF/B-IV. Stehn, J. R. (Brookhaven National Lab., Upton, NY). Trans. Amer. Nucl. Soc.; 18: 351(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17394 YIELDS AND GENETIC HISTORIES OF ^{128}Sb, ^{129}Sb, AND ^{130}Sb FROM THERMAL-NEUTRON INDUCED FISSION OF ^{235}U. Fowler, N. M.; Wahl, A. C. (Washington Univ., St. Louis). J. Inorg. Nucl. Chem.; 36: No. 6, 1201-1212(Jun 1974).

The following fractional independent yields have been determined: 10-min ^{128}Sb, ≤ 0.037; 9.1-hr ^{128}Sb, 0.031 ± 0.005; ^{129}Sb, 0.114 ± 0.046; 6.3-min ^{130}Sb, 0.202 ± 0.030; 40-min ^{130}Sb, 0.138 ± 0.034. The cumulative yield of ^{130}Sn has been determined to be 0.89 ± 0.10%, and the following chain yields have been derived from this, the fractional independent yields and literature values: A = 128, 0.344 ± 0.018%; A = 129, 0.61 ± 0.03%; A = 130, 1.43 ± 0.18%. It has also been determined that 3.1 ± 0.2% of ^{128}Sn decays to the 9.1-hr ^{128}Sb isomer and that 52.9 ± 3.4% of ^{129}Sb is formed by decay of 2.5-min ^{129}Sn and 35.7 ± 3.0% is formed by decay of 7.4-min ^{129}Sn. Rapid chemical separation procedures are described, and a method is discussed of correcting gamma-ray peak areas determined with a Ge(Li) detector for decay of activities and for changing analyzer dead-time during each counting period. The yields of the antimony isotopes are all somewhat smaller than estimated "normal" yields, as has usually been observed for odd Z nuclides. The data help to show that most of the large initial increase in yield with mass number above A = 125 is due to the increasing cumulative yields of tin isotopes, an indication that closure of the 50-proton shell is an important cause for the high probability of asymmetric mass division in low energy fission. (auth)

17395 THERMAL-NEUTRON FISSION OF ^{226}Ra. Nakahara, H.; Ikeda, T.; Hashimoto, T. (Niigata Univ., Japan). J. Inorg. Nucl. Chem.; 36: No. 3, 487-493(Mar 1974).

Thermal-neutron fission cross-section of ^{226}Ra was measured by fission track detectors (polycarbonate), and it was found that the cross-section was 4.7 mbarn, which is more than ten times larger than the previously reported values. Fission-product yields were also investigated as a function of complementary fragment mass ratio by measuring the track lengths of fragment pairs. The range–energy conversion was carried out by using a simplified Bohr's formula. It was found that symmetric fission mode is dominant in the ^{226}Ra thermal-neutron fission, in contradiction to the generally accepted view that asymmetric mass division is favored at low excitation energy. The accuracy of the track length measurement was checked by the well-known fission systems of ^{235}U thermal-neutron fission and ^{252}Cf spontaneous fission. (auth)

17396 PROPERTIES OF ^{3}H-PARTICLES EMITTED DURING THE THERMAL NEUTRON-INDUCED FISSION OF ^{239}Pu. Brera, C.; Fossati, F.; Pinelli, T. (Univ., Pavia, Italy). Lett. Nuovo Cim.; 10: No. 3, 93-96(18 May 1974).

Experimental results on the angular distribution of ^{3}H particles emitted in the thermal fission of ^{239}Pu are reported. The analysis is limited to particle energies between 3.5 and 7 MeV. Angular distributions are shown with respect to the observed fragment and the light fragment. The average energy of the ^{3}H particles in the above energy range is plotted as a function of angle with respect to the direction of the light fragment. Angular distributions of ^{4}He and ^{6}He particles emitted in this fission are also discussed.

It is concluded that only one mechanism is responsible for the emission of these particles in fission, and that the point of emission of ^{3}H is broadly distributed around the minimum of the potential energy—particles with the highest energy are emitted from points very near to either fragment. (3 figures, 2 tables) (RWR)

17397 EJECTION OF ATOMS FROM SURFACE OF ELECTRODEPOSITED URANIUM SOURCES BY ALPHA DECAY OR FISSION REACTION. Hashimoto, T. (Kyoto Univ.). Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 6: 10-17(Sep 1973).

The atoms ejected in vacuo from the surface of some thinly electrodeposited uranium sources, such as uranium-233, enriched (90%) and natural uranium, by alpha decay or fission reaction processes were determined. Aluminium plates were used as collectors. Alpha emitters on the collector and the source were detected by alpha ray spectrometry and the amount of fission products was determined by gamma ray spectrometry using a Ge(Li) detector. The deposition of uranium was also examined by means of fission track method using a muscovite detector. Only daughter nuclides of the concomitant ^{232}U in the ^{233}U sample were found on the collector subjected to alpha decay process, while all nuclides produced from the ^{233}U source by fission reaction process were detected on the collector. The number of uranium atoms knocked out by one fission process were evaluated to be the range of 300 to 1000 under applied thermal neutron fluence of 8.42×10^{16} cm^{-2}. (auth)

17398 MEASUREMENT OF THE CROSS SECTION FOR THE $^{237}Np(n,f)$ REACTION. Kobayashi, K. (Kyoto Univ.); Kimura, I.; Gotoh, H.; Yagi, H. Annu. Rep. Res. Reactor Inst., Kyoto Univ.; 6: 1-9(Sep 1973).

The energy dependent cross section for the $^{237}Np(n,f)$ reaction was measured in the neutron energy region from 3.5 MeV to 4.9 MeV with a 2 MeV Van de Graaff accelerator making use of a chamber composed of a silicon detector and an electrodeposited ^{237}Np film. The average cross section for this reaction was measured in a reactor core with a fission-type-reactor spectrum and with a fission plate. The former was performed with the silicon detector and the latter by induced activity measurement of ^{140}La–^{140}Ba. Both the results, 1.32 ± 0.07 and 1.33 ± 0.11 barns, agreed within the limits of error and close to the earlier values. From a comparison of the measured average cross section with the calculated, it can be seen that the Maxwellian is adequate as the fission neutron spectrum and the energy dependent cross sections in ENDF/B-II and UKNDL are recommendable assuming the Maxwellian form. (auth)

17399 RATIO OF THE ^{233}U TO ^{235}U FISSION CROSS-SECTION. Meadows, J. W. (Argonne National Lab., IL). Nucl. Sci. Eng.; 54: No. 3, 317-321(Jul 1974).

Measurements of the ^{233}U :^{235}U fission cross-section ratio were carried out in the energy ranges 0.1 to 3.0 MeV and 4.5 to 7.5 MeV with accuracies of ~1%. Relative masses of the fissile samples were obtained from the alpha activities and also from the relative thermal fission ratios. (1 figure, 4 tables) (auth)

Nuclear Theory

Refer also to abstracts 17033, 17297, 17336, and 17384.

17400 (ANU-P-590) CURRENT TOPICS OF PRIME INTEREST IN NUCLEAR PHYSICS. Lectures by Dr. A. M. Lane of A. E. R. E., Harwell. Frawley, A. D.; Slocombe, M. G. (Australian National Univ., Canberra. Inst. of Advanced Studies). Mar 1974. 58p. Dep. NTIS (U.S. Sales Only) $6.00.

The following topics are discussed briefly in a series of 6 lectures: 1) level distributions, 2) nonstatistical effects in neutron capture, 3) (d,p) threshold anomalies, 4) the interplay of direct and compound-nuclear reactions, 5) analogue states, 6) collective states, 7) nuclear moments of inertia, 8) heavy ions, 9) weak interactions, 10) electron scattering, 11) Coulomb mixing effects, 12) various direct reaction problems, 13) π–nucleus and K–nucleus interactions, 14) three body problems. (AT)

17401 (AREAEE-178) NUCLEAR REACTION KINEMATICS PROGRAM "NCKN". Comsan, M. N. H. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 26p. Dep. NTIS (U. S. Sales Only) $4.50.

The program "NCKN" is described. It is an automatic computer program written in FORTRAN IV for the calculation of various kinematical relationships that are needed for particle identification and cross-section transformation in nuclear physics. The program is written for the use on IBM-1130 computer. The core storage required for the program is 3 K. The report contains the program listing along with sample input to and output from the program. (auth)

17402 (CONF-740126-1) INSTABILITIES OF MATTER IN STRONG EXTERNAL FIELDS AND AT HIGH DENSITY. Klein, A.; Rafelski, J. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 5 Mar 1974. Contract AT(11-1)-3071. 57p. Dep. NTIS $6.00.

From theoretical studies conference; Coral Gables, Florida, USA (7 Jan 1974).

In the recent literature, there have been a number of theoretical studies of new phenomena involving the instability of the ground state (sometimes called the vacuum state) of various fundamental forms of matter under unusual perturbations. Two examples of instability are considered in detail under the application of Coulomb fields of superheavy nuclei, against the emission of positrons and the creation of a condensate of charged pion pairs. The former may occur for atomic number $Z \sim 170$, whereas the latter requires $Z > 10^3$. The theory of possible forms of pion condensation inside nuclear matter and neutron star matter is also discussed. By careful attention to fundamentals, an effort is made to clarify some of the controversy now raging in the literature concerning these speculations. (auth)

17403 (COO-2171-39) NUCLEAR STRUCTURE THEORY. Annual Technical Progress Report, July 1, 1973–June 30, 1974. French, J. B.; Koltun, D. S. (Rochester Univ., N. Y. (USA)). 1974. Contract AT(11-1)-2171. 10p. Dep. NTIS $4.00.

This report summarizes progress during the last year in the following areas of nuclear structure and reaction theory: theory of the effective interaction, including behavior of the expansion in orders of the reaction matrix; meson interactions with nuclei, including inelastic scattering of pions, and three-body theories of scattering and absorption of pions by deuterons; statistical spectroscopy including level densities, low-lying spectra and ground-state energies for complex nuclei, sum rules and strength distributions for various excitation processes; nuclear symmetries including their effects on α-transfer cross-sections, and symmetry breaking as measured by partial widths connecting different representations. (auth)

17404 (COO-3071-91) BOSON-LIKE EXPANSIONS WITHOUT BOSONS: APPLICATION TO SEVERAL EXACTLY SOLUBLE SHELL MODELS WITH COLLECTIVE FEATURES. Chattopadhyay, P. K.; Klein, A.; Krejs, F. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 19 Mar 1974. 47p. Dep. NTIS $5.50.

It is recognized that the generators of a Lie algebra can be divided into three sets (Y^+, Y, Z). The set Y^+ acting on a reference state generates a basis, and Y generates the dual basis; it follows that any Z can be expressed as a polynomial in the Y^+ and Y. Examples of such expansions for the algebra SU(2) and R(5), as well as for the algebras of more realistic shell-model problems, are presented. These expansions play an essential role in approximate and successful algebraic studies of two exactly soluble models: the SU(2) model of Meshkov, Glick, and Lipkin and an R(5) symmetric model of vibrations and rotations in a plane devised by the authors. (5 tables) (auth)

17405 (CRN-T-74-01) MICROSCOPIC DESCRIPTION OF COLLECTIVE STRUCTURES IN LIGHT NUCLEI. Caurier, E. (Strasbourg-1 Univ., 67 (France)). Jan 1974. 131p. (In French). Dep. NTIS (US Sales Only) $9.75.

Thesis.

The existence of rotational bands in nuclei has been known for a long time. Inelastic (p,p') and (e,e') scattering experiments have recently led to the discovery of T = 0 giant resonances. The aim of this work was to describe these rotational and vibrational structures using a microscopic approach, that is by dealing directly with the nucleon-nucleon interaction. The Hill–Wheeler generator coordinate method, was used together with Hartree–Fock theory for light 4n nuclei in 1p shell and first half of (2s-1d) shell. Two models were used: deformed harmonic oscillator; Brink–Margenau α cluster model. Energies, rms radii, and electromagnetic properties were computed in this way, and several interesting results obtained. As an example, the falling-off of E2 transition ratio was correctly described as a function of increasing angular momentum for rotational bands (The Bohr–Mottelson model gives exactly the opposite variation). Some predictions about giant resonances (monopolar or quadrupolar) were also possible. (auth)

17406 (EUR-5054) NEUTRON SPIN PRECESSION IN POLARIZED NUCLEAR TARGETS. Forte, M. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Feb 1974. 18p. Dep. NTIS (U. S. Sales Only) $4.00. EUR B. Fr. 40.-.

When a neutron beam is transmitted by a polarized nuclear target, the spin-dependent part of the neutron optical potential causes a neutron spin precession. The connection of this poten-

tial with the nuclear scattering amplitudes is reviewed with regard to the approximations involved in current formulations. The neutron spin precession, modified by a spin dependence of the neutron wave attenuation, is described analytically. The principles and preliminary results are presented of new experiments which measure directly a neutron spin rotation, proportional to the spin-dependent real part of the scattering amplitude. (4 figures) (auth)

17407 (JINR-P1-7888) ESTIMATE OF THE CROSS SECTION OF THE COHERENT PION ELECTROGENERATION IN RELATIVISTIC NUCLEUS COLLISIONS. Tolstov, K. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Estimate of the cross section of the high energy pion generation at relativistic nucleus collisions is made on the basis of the virtual proton model, the scale invariance principle and experimental data on pion generation by electrons. (auth)

17408 (JINR-P2-7871) SPACE-TIME DEVELOPMENT OF THE HADRON MULTIPLE PRODUCTION PROCESS AND THE MECHANISM OF THE "TOTAL" NUCLEAR DISINTEGRATION. Kalinkin, B. N.; Shmonin, V. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 22p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

The analysis of the interaction of hadron clusters with the nucleus shows that it can result in a "total" disintegration of the nucleus. (auth)

17409 (JINR-P4-7922) REFERENCE SPECTRUM METHOD MODIFICATION FOR SOLVING THE BETHE-GOLDSTONE EQUATION FOR FINITE NUCLEI. Bal'butsev, E. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The reference spectrum method is modified so that only algebraic operations are required to obtain reaction matrix elements for finite nuclei. No differential equations should be solved. The Pauli operator is treated exactly. A one-particle potential can be arbitrary, but a two-particle interaction must not have a hard core. (auth)

17410 (JINR-P4-7967) METHOD FOR CALCULATION OF ENERGIES AND WAVE FUNCTIONS FOR LOW-LYING STATES OF ODD-MASS NUCLEI. Dzholos, R. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Various methods are analyzed used for description of the low lying odd-mass nucleus states. It is shown that, when describing the states (the one-quasi-particle component of which is close to the Fermi surface), the method, that uses expansion of the wave function in the one-quasi-particle and one-phonon components, leads to noticeable errors. (auth)

17411 (JINR-P7-7915) NONEQUILIBRIUM PROCESSES IN MULTINUCLEON TRANSFER REACTION. Gudima, K. K.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

It is shown that the experimentally observed dependence of the isotopic yield in multinucleon transfer reactions on the Q-value for the ground state transitions of nuclei can be interpreted without using the compound nucleus concept. Comparison with experimental data indicates that nonequilibrium processes play an essential part in the reactions discussed. (auth)

17412 (ORNL-4937, pp 204-232) THEORETICAL PHYSICS. May 1974.

In Physics Division annual progress report for period ending December 31, 1973.

The rationale behind the theoretical physics program is explained, the various phases of work are summarized, and then 16 individual papers are presented. Most of the work can be grouped into four broad areas: Brueckner-Hartree-Fock studies of basic nuclear structure; shell-model calculations of the properties of low-lying nuclear states in terms of a few valence nucleons; investigations of collective properties, such as nuclear fission, heavy-ion collisions, and exotic nuclear configurations (bubbles, toroids, etc.); and direct nuclear reaction studies, both to understand the reaction mechanism and as a tool for extracting nuclear structure information from experimental data. Increasing attention has been paid to the physics of heavy-ion collisions. (RWR)

17413 (RLO-2225-T-27-4) PROGRESS REPORT, MAY 15, 1973-March 5, 1974. Lord, J. J.; Kirkpatrick, L. D. (Washington Univ., Seattle (USA). Dept. of Physics). 5 Mar 1974. Contract AT(45-1)-2225. 19p. Dep. NTIS $4.00.

Work has continued on the study of high energy particle interactions with heavy nuclei. A new theory developed during the past year by K. Gottfried has directed attention to a number of important implications of the investigation of the intranuclear cascade. Experiments in the laboratory were aimed at the determination of the dependence of the multiplicity on the atomic mass number, A, of the target nucleus. Emulsions with granule targets of elements from A = 10 to A = 232 were bombarded by 300 GeV protons, 22 GeV protons, and 2.1 GeV/nucleon oxygen ions. Interpretation of the data at the present time favors coherent type production models. (auth)

17414 SUM RULES, NUCLEAR STRUCTURE, AND FORM FACTORS FOR ISOSCALAR ELECTROEXCITATIONS. Deal, T. J. Providence, RI; Brown University (2 Jul 1974). 106p. University Microfilms Order No. 74-2998.

Thesis (Ph.D.).

A formalism for generating energy-weighted isoscalar sum rules is obtained from a single equal-time current commutator. This yields infinite collections of different sum rules, each of which is a sum over excited nuclear states, and whose terms involved inelastic form factors for nuclear transitions (functions of momentum transfer q) and/or matrix elements for the moments of these transitions. These are natural generalizations of familiar sum rules such as that of Thomas-Reiche-Kuhn. Several sum rules are considered, whose limits (i.e., the single term on the right-hand sides) are functions of q, but are given in terms of experimentally known quantities such as the elastic form factors. Included are sum rules of given parity and multipolarity. The sum rules have several uses. First, when inelastic form factors are known for several states, the fraction of the sum rule limit which is exhausted by these states (i.e., the oscillator strength junction—which is now a function of q) may be plotted as a function of q, and limitations on the remaining yet unknown states may be deduced. This is analogous to the familiar procedure involving already known sum rules, to which these sum rules often reduce in the limit of zero momentum transfer. However, for a given single nuclear state, an infinite variety of sum rules are applicable. Second, the sum rules are considered in terms of a response function formalism in order to study the effects that a perturbation of a nucleus (e.g., excitation by a virtual photon of a given character and multipolarity) has on the inelastic form factor. A "doorway dominance" approximation may then be introduced, which effectively causes all of the terms in the sum to collapse into a single equivalent term. This approximation allows predictions for a single inelastic form factor to be made. The results are compared to existing data, and good agreement is found for most cases until near the region of the first Born minimum, where deviation from the approximation sets in. These deviations do not indicate a failure here of the general approach, but rather provide useful information for its extension. (Diss. Abstr. Int., B)

17415 MOMENTS OF THE DISTRIBUTION OF WIDTHS CORRESPONDING TO AN ENSEMBLE OF RANDOM MATRICES. McDonald, J. F. (Univ. of Windsor, Ont.). J. Math. Phys. (N.Y.); 15: No. 5, 596-601 (May 1974).

The moments of the width distribution corresponding to an ensemble of random matrices are discussed. The ensemble considered is one where the real and imaginary parts of the Hamiltonian matrices have Gaussian distributions with different widths. In particular, exact expressions are given for the moments when N = 2 (N = dimension of the Hamiltonian submatrix with a fixed set of quantum numbers) and a method is given for obtaining a power series representation when N is arbitrary. (auth)

17416 MAGNITUDE OF THE DEFORMATION OF THE PROTON-NUCLEUS SPIN-ORBIT COUPLING. Verhaar, B. J. (Technische Hogeschool, Eindhoven, Netherlands). Phys. Rev. Lett.; 32: No. 6, 307-310 (11 Feb 1974).

A simple explanation is presented for the observed tendency of the spin-orbit part of the optical potential for a proton scattered by a nonspherical target nucleus to be more deformed than the central part. The explanation is based on the fact that the range of the central two-body force is longer than that of the two-body spin-orbit force. (auth)

17417 TOTAL PROBABILITY OF K-ELECTRON SHAKE-OFF IN BETA-DECAY. Isozumi, Y.; Mukoyama, T.; Shimizu, S. (Kyoto Univ.). Lett. Nuovo Cim.; 10: No. 8, 355-359 (22 Jun 1974).

The K-electron shake-off process (KSO) recently developed in which the phase space sharing among the three leptons (beta particle, K-electron, and antineutrino) in the final state and the indistinguishability of the two continuum electrons taken into account, is discussed. It is asserted that the comparison of this theory with other previous theories reveals a serious inconsistency; the total KSO probability deduced from the studied theory does not approximate to that from the simple overlap theory in the limit where effects of the phase space sharing and the indistinguishability become negligibly small. (JFP)

17418 GENERAL EQUATION FOR THE KINETICS OF LINEAR FIRST ORDER PHENOMENA AND SUGGESTED APPLICATIONS. Skrable, K.; French, C.; Chabot, G.; Major, A. (Lowell Technological Inst., MA). Health Phys.; 27: No. 1, 155-157(Jul 1974).

An equation is given which may be applied to the serial transformation by radioactive decay of each member of a radioactive series or any system obeying linear first order kinetics, for example, chemical reactions. The equation gives the quantity of any member of a serial transformation allowing for any linear first order production and destruction phenomena, initial values for all members, constant independent production rates for all members, and unlimited branching. (UK)

17419 MICROSCOPIC THEORY OF THE SO-CALLED TWO-PHONON STATES IN EVEN-EVEN NUCLEI. II. Formulation. Kanesaki, N. (Kyushu Univ., Fukuoka); Sakata, F.; Takada, K.; Marumori, T. Progr. Theor. Phys. (Kyoto); 50: No. 3, 867-890 (Sep 1973).

It is the main purpose to develop a clear-cut formulation in constructing the dressed four-quasi-particle modes proposed previously within the framework of the quasi-particle-new-Tamm-Dancoff method. As already discussed, the construction of the dressed four-quasi-particle modes accompanies various complications when compared with the case of the conventional dressed two-quasi-particle modes, i.e., the phonons. To avoid the puzzling complications, explicitly establish a concept of quasi-particle-new-Tamm-Dancoff space which is related inherently to the quasi-particle-new-Tamm-Dancoff method. When the concept is explicitly used, the formulation within the framework of the new-Tamm-Dancoff approximation becomes especially simple. (auth)

17420 ANTISYMMETRIZATION IN RELATIVE COORDINATES. I. A General Theory for N Particles. Miglietta, F. (Univ., Pavia, Italy). Nuovo Cim.; 22A: No. 1, 57-65(1 Jul 1974).

A general theory to construct, for N nucleons in relative coordinates, an orthonormalized basis of orbital states, with definite symmetry under particle permutations, is given. Orbital states are obtained as eigenstates of a model Hamiltonian which describes the relative motion of N particles interacting through harmonic forces. A basis of totally antisymmetrized states can be obtained by combining such orbital states with spin-isospin states, with exactly the same rules as in the usual shell model theory. A sketch of the theory to diagonalize, over a basis of this kind, a Hamiltonian with a local potential is given. (auth)

17421 ANTISYMMETRIZATION IN RELATIVE COORDINATES. II. Fractional-Parentage Coefficients. Miglietta, F. (Univ., Pavia, Italy). Nuovo Cim.; 22A: No. 1, 66-78(1 Jul 1974).

In the framework of a theory to construct an antisymmetrized basis in relative co-ordinates for an N-nucleon system, a method to calculate the $(N|N-1)$ fractional-parentage coefficients is given. The theory, which involves the main properties of the Young-Yamanouchi orthogonal representation of the permutation group S_N, gives the orbital f.p.c. as solutions of an algebraic system of linear homogeneous equations. (auth)

17422 DWBA ANALYSIS OF HEAVY-ION TRANSFER REACTIONS. I. Anni, R.; Taffara, L. (Univ., Lecce, Italy). Nuovo Cim.; 22A: No. 1, 11-24(1 Jul 1974).

The DWBA matrix element, obtained from the post-representation by neglecting the term depending on the difference between the core-core optical potential and the final-channel optical potential, is integrated on the angular variables for bound-state central potentials, after expanding the two scattering wave functions in partial waves. The original six-dimensional integral can then be reduced to a fourfold radial integral without any assumption about the form of the bound-state and scattering functions. The Buttle and Goldfarb approximation, when possible, reduces the fourfold integral to a threefold integral. The final expression can be used for the exact numerical calculation of the DWBA matrix element. (auth)

17423 EXPANSION OF A FUNCTION SUM OF TWO VECTORS AS APPEARING IN THE RECOIL EFFECT IN NUCLEAR TRANSFER REACTIONS. Elbaz, E.; Meyer, J.; Nahabetian, R. (Univ. Claude Bernard, Lyon). Lett. Nuovo Cim.; 10: No. 10, 417-421 (6 Jul 1974).

The problem of the very bad convergence in the expansion of the bound wave functions for approximate first-order treatments of the recoil effect in heavy-ion reactions is studied. An attempt is made to solve directly the problem of expanding the function of a sum of two vectors. Two different solutions of that problem are given. The very interesting results obtained are discussed. (JFP)

17424 MESONIC EXCHANGE CONTRIBUTIONS TO NUCLEAR PHOTO REACTIONS. Gari, M. (Univ., Bochum, Ger.). (1974). vp.

From symposium on mesonic effects in nuclear structure in remembrance of K. Erkelenz; Bonn, Germany (29 Jan 1974).

In the present investigation we discuss the importance of mesonic effects in processes like (γ,n), (γ,p), (γ,pn), (γ,pp) and (γ,nn). The description of these reactions in the shell model, as well as in extended shell models (Jastrow, Brueckner-Goldstone correlations), has not been satisfactory. We show that with a systematic treatment of the exchange currents, in the simplest approach, it is possible to explain the existing discrepancy between experiment and the pure shell model. The reason for the similar behavior of the reactions (γ,p) and (γ,n) is explained, as well as the suppression of the reactions (γ,pp) and (γ,nn) relative to (γ,pn). Numerical examples are given in the case of ^{4}He for the reactions (γ,p) and (γ,n). (3 figures) (auth)

17425 NUCLEAR FORCES IN NUCLEI AND ALPHA-CLUSTERIZATION. Akaishi, Y. (Hokkaido Univ.; Sapporo); Bando, H.; Nagata, S. Progr. Theor. Phys. (Kyoto), Suppl.; No. 52, 339-375(Aug 1973).

Investigation into clustering phenomena on the basis of realistic nuclear force is an interesting and promising problem. The mechanism of the alpha-clusterization of a nucleus should be closely related to the mechanism which assures the saturation of overall nuclei including alpha-particle and heavy nuclei. The saturation property of nuclei depends strongly on the characteristics of nuclear forces. The saturation problem has not yet been solved at present. Some quantitative ambiguity still remains in the treatment of many-body problem, and uncertainty remains in two-body nuclear force. It is necessary to investigate three and four-body problems (^{3}H,^{3}He and ^{4}He), in order to develop nuclear matter theory, and also to clarify the mechanism of the variation of binding energy in overall nuclei from very light nuclei to heavy ones including the nuclear matter as a limit. This is called "overall saturation" mechanism. To understand the binding mechanism of alpha-particle is a basic subject for the problem of the alpha-clusterization. This is the first subject. The second subject is to attempt to relate the problem of alpha-clusterization to the characteristics of realistic nuclear force, with these achievements on the saturation problem at the present stage as background. The Pauli exchange and the characteristic of nuclear force which is short-range attractive in S-states and weak in P-states are essential to realize "internally strong but externally weak" nature characterizing alpha cluster structure. An important role of strong tensor force in the triplet-even state which is another characteristic of the nuclear force is stressed. This problem is treated by applying the reaction matrix method on a cluster model. (Kato, T.)

17426 SHAPE OF MOESSBAUER SPECTRA IN THE FAST RELAXATION LIMIT. Afanas'ev, A. M.; Gorobchenko, V. D. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 66: No. 4, 1406-1418(Apr 1974). (In Russian).

It is shown that in the limit of fast relaxation, when the electron spin relaxation time is small but finite and the relaxation process is manifest in an asymmetry of the quadrupole doublet or in a pronounced line broadening, one can find, by analyzing the Moessbauer spectra, the zero frequency Fourier component for the correlation functions $S^i(t)S^j(0)$, where S^i is the t^{th} component of the Moessbauer atomic shell spin. A large variety of spectral shapes can be described by the formula by employing only a few parameters. Since the formulas have been derived from basic principles and in this sense are exact, they yield very definite information about the relaxation process on basis of the Moessbauer data. (auth)

17427 SIMPLE MODEL FOR NUCLEAR DENSITY OSCILLATIONS. de Llano, M. (Universidad Nacional de Mexico, Mexico City); Quintanilla, J. Rev. Mex. Fis.; 22: No. 3, 273-280(1973).

By using rigid-wall boundary conditions, the probability density of an N-fermion system is calculated in one dimension as the sum of the N lowest-energy standing waves enclosed in a given length L. The result agrees qualitatively both with previous, more elaborate theories and with experiments on nuclear density oscillations and surface thickness. A simple calculation of the surface energy is done and found to be of the right sign. (6 figures) (auth)

17428 NUCLEAR FORCES IN MOMENTUM SPACE WITH ONE-BOSON-EXCHANGE MODEL. II. Hoshizaki, N.; Kadota, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 51: No. 1, 311-313 (Jan 1974).

It has been shown [Progr. Theor. Phys. (Kyoto) 50: 1312(1973)] that experimental phase shifts in the energy region from 10 to 400 MeV could be reproduced by using a one-boson-exchange potential with six kinds of bosons as calculated in momentum space (p-space). It is shown here that the N-N experimental data below 10 MeV are also reproduced by the potential in p-space calculated previously. The results are tabulated, and matrix elements of the potential are plotted in (p',p)-space. (2 figures, 1 table) (RWR)

17429 INELASTIC SCATTERING KERNEL FOR FAST NEUTRONS. Syros, C. (EURATOM, Brussels). Ann. Nucl. Sci. Eng.; 1: No. 3, 234(Mar 1974).

The author replies briefly to reference to an error in his work on inelastic scattering made by Williams [J. Nucl. Energy, 35: 489-501(1971)]. (UK)

17430 CONSISTENT TREATMENT OF THE COUPLING BETWEEN THE PAIRING-VIBRATIONAL AND TWO-PHONON STATES. Hasegawa, M. (Fukuoka Dental Coll.). Progr. Theor. Phys. (Kyoto); 51: No. 1, 309-311(Jan 1974).

The coupling between excitation modes is treated in the framework of the new Tamm–Dancoff approximation. The pairing and λ-pole particle–hole (p–h) correlations are considered. Expressions for 2p–2h modes and the total Hamiltonian are written down. The method is applied to the lowest two 0^+ states in ^{208}Pb which can be regarded as a system having the pairing plus $Y_3 \cdot Y_3$ interaction. It is found that the lowest two 0^+ states in ^{208}Pb are mainly produced by the pairing and octupole p–h correlations. It is concluded that both the coupling and the effects in diagonal matrix elements must be carefully treated. (1 figure) (RWR)

17431 STATE DENSITY PARAMETER OF NUCLEONS IN A DIFFUSE NUCLEAR WELL. Gottschalk, P. A. (Univ., Marburg, Ger.). Z. Phys.; 267: No. 2, 157-160(Mar 1974). (In German).

The state densities of nucleons in a diffuse nuclear well are calculated by using the WKB method. Using realistic values for the potential parameters and a smooth empirical Fermi level, we find a state density parameter a in agreement with experiment. (2 figures) (auth)

17432 ENCYCLOPEDIA OF PHYSICS. Second Edition. Besancon, R. M. (ed.). New York; Van Nostrand Reinhold Company (1974). 1079p. $37.50.

The encyclopedia contains articles on major areas of physics and the major divisions and subdivisions of these areas that attempt to define these areas and describe the concepts involved. Many new concepts have been added or expanded. The articles are cross referenced and contain references to the recent literature. A subject index is included. (CES)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 14946, 14930, 15554, 15590, 15598, 15759, 15779, 15858, 15869, 15872, 15873, 15903, 15985, 16029, 16396, 16679, 16755, 17382, 17506, 17513–17515, and 18033–18035.

17433 (AEC-tr-7546) PROBLEMS IN THE THEORY OF MULTIPLE SCATTERING OF PARTICLES. Galishev, V. S. Jun 1974. Translation of Voprosy Teorii Mnogokratnogo Rasseyaniya Chastits, Atomizdat, Moscow, 1972. 115p. Dep. NTIS $5.45.

A number of boundary problems were studied with respect to the transmission of γ-quanta, electrons and protons through a material. In particular, in it there is a detailed discussion of the simplest boundary problem of the transmission of particles through a layer of material. In this research the most general approximate methods of solving the kinetic equations are used permitting the application of computers in the known step. Special attention has been given to the very interesting and fruitful Yvon–Mertens method which, unfortunately, has not been properly publicized in Soviet literature. All of the calculation results are presented in the form of graphs or tables and can be used to compare the theory with the experiment. (13 tables, 5 figures, and 82 references.) (auth)

17434 (ANL-8080, pp 19.1-19.9) CALCULATION OF CENTRAL AXIS PERCENTAGE DEPTH-DOSES. Pacyniak, J. M.; Pagnamenta, A. (Univ. of Illinois, Chicago). 1973.

In proceedings of the symposium on advanced technology arising from particle physics research, May 17, 1973.

A simple derivation of an accurate and practical expression for the central axis depth dose for electrons in the MeV range is presented. (MHR)

17435 (ANL-8081) APPROXIMATION PROCEDURE FOR THE NEUTRON TRANSPORT EQUATION BASED ON THE USE OF SURFACE HARMONIC TENSORS. Kaper, H. G.; Leaf, G. K.; Lindeman, A. J. (Argonne National Lab., Ill. (USA)). Feb 1974. Contract W-31-109-eng-38. 49p. Dep. NTIS $4.00.

A unified presentation of the surface harmonic method in neutron transport theory is presented. Emphasis is on the formal aspects of the method and the mathematical principles underlying it. The presentation is based on the self-adjoint form of the transport equation and the use of surface harmonic tensors. (auth)

17436 (CONF-721018-(Vol.2), pp 236-252) "ANATOMY" OF RADIATION TRANSMISSION, DEVELOPED BY A SEMI-ANALYTICAL SIMULATION OF RADIATION TRANSPORT. Biro, G. G. (Gibbs and Hill, Inc., New York). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A new semi-analytical model to simulate radiation transport, as described by the Boltzmann equation, is presented. While a particle was followed from collision to collision, the spatial variable was integrated analytically, and the angular variables were integrated by both conventional and Monte Carlo techniques. The output details the transmission of each order of collision by tracing the contribution of any order of collision in each energy interval in each direction separately. In addition, it integrates the accumulated contribution from the first to each order of collision, thus providing all orders of collision-bound angular and energy spectra. There is no limitation to the calculation of segregated contribution of any higher order of collision. The output furnishes the whole skeleton of the transmission results as they are built up from their components. (auth)

17437 (CONF-721018-(Vol.2), pp 268-283) MOMENTS METHOD CALCULATIONS OF NEUTRON AND GAMMA-RAY PENETRATION IN BULK MEDIA. Simmons, G. L. (Babcock and Wilcox Co., Lynchburg, VA); Eisenhauer, C.; Spencer, L. V. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A system of computer codes using the moments method to calculate penetration of neutrons and gamma rays in bulk media is described. Results are presented for the penetration of fission neutrons incident at various angles on concrete. The use of adjoint procedures for calculating gamma ray buildup factor data are also described and results are presented for the penetration of gamma rays from point sources emitting at various conical angles in a concrete medium. Finally, the two types of calculations are combined to produce data for penetration of gamma rays produced in concrete by a neutron source. (auth)

17438 (CONF-740703-3) ABSORBED DOSE IN PHANTOMS WHICH REPRESENT VARIOUS AGED MALE HUMANS FROM EXTERNAL SOURCES OF PHOTONS AS A FUNCTION OF AGE. Warner, G. G.; Poston, J. W.; Snyder, W. S. (Oak Ridge National Lab., Tenn. (USA)). 1973. 18p. Dep. NTIS $4.00.

From computer simulation conference; Houston, Texas, USA (9 Jul 1974).

It has long been suggested that there might be a large variation in absorbed dose among various aged humans. One expects this to be the result of the effect of the inverse square law in cases where the sources of radiation are internal. Now, studies have been made with the use of a computer to assess the photon dose received by various phantoms representing different aged male humans due to external sources. The studies included 12 monoenergetic infinite external sources, ranging in energy from 10 keV to 4 MeV, and 6 phantoms, representing a newborn, a 1 year old, a 5 year old, a 10 year old, a 15 year old, and an adult. The data indicate that dose to the genitalia of a newborn might be 3 times higher than dose to the genitalia of an adult at higher emitter energies or 30 times as high at the lowest emitter energy. In general, from the 1 year old upward in age, dose decreases with age. (auth)

17439 (EUR-5122(Vol.2)) FOURTH SYMPOSIUM ON MICRODOSIMETRY, VERBANIA PALLANZA, ITALY, 24–28 SEPTEMBER 1973. Booz, J.; Ebert, H. G.; Eickel, R.; Waker, A. (Eds.). (Commission of the European Communities, Luxembourg). Mar 1974. 520p. (In Several Languages). (CONF-730952-P2). EUR B.Fr. 1.000.

Separate abstracts were prepared for twenty-five papers. (MHR)

For abstracts of individual papers see: 14932, 15590–15599, 15645, 15779, 15795, 17303, and 17440–17449.

17440 (EUR-5122(Vol.2), pp 677-693) FANO'S THEOREM AND THE MULTIPLE SCATTERING CORRECTION. Harder, D. (Univ., Wuerzburg, Ger.). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

A "perturbation correction factor" has been introduced in electron dosimetry to correct for the increase or decrease of the primary electron fluence within low-density cavities caused by multiple scattering. The possible application of this concept to Bragg–Gray cavities used in photon dosimetry however contradicts Fano's theorem according to which the electron fluence is density-independent in a medium of uniform composition uniformly irradiated by photons. For an analysis of this situation, the boundary conditions which establish Fano's solution of the transport equation are investigated and formulated as an extension to Fano's theorem. The cases in which the theorem does not apply can then be specified, e.g. the buildup and transition regions of the electron fluence in a photon-irradiated medium and regions of non-uniform photon fluence. In low-density cavities inserted into these regions multiple scattering effects may disturb the electron fluence, so that appropriate perturbation correction factors will have to be derived and cavity design should minimize these effects. Microdosimetric distributions in proportional-counter cavities inserted into photon (or neutron) irradiated regions in which Fano's theorem does not apply are likewise affected. (auth)

17441 (EUR-5122(Vol.2), pp 695-715) SOME NEW TRANSPORT CALCULATIONS OF THE DEPOSITION OF ENERGY IN BIOLOGICAL MATERIALS BY LOW-ENERGY ELECTRONS. Berger, M. J. (National Bureau of Standards, Washington, DC). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

After some brief remarks about the method of calculation and cross sections, illustrative results are given from recent electron transport calculations. The following topics are discussed: (1) the distribution of absorbed dose in water around point-isotropic and point-monodirectional electron sources; (2) the radial distribution of absorbed delta-ray energy around proton tracks in nitrogen; (3) the frequency mean and energy mean of microdosimetric event-size distributions in small spherical volumes in water, for the case of irradiation by electrons and tritium beta-rays; (4) the perturbation of event-size distributions in gas-filled cavities due to the presence of surrounding walls. (auth)

17442 (EUR-5122(Vol.2), pp 717-732) SIMULATION OF THE TRANSPORT OF ELECTRONS WITH ENERGY LESS THAN 1 keV BY A MONTE CARLO METHOD. Terrissol, M.; Patau, J. P. (Univ. Paul Sabatier, Toulouse). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

A hit-by-hit simulation is made. This method consists in simulating one by one the elastic or inelastic interactions of the incident electron with the atoms of the moderator. The exact relativistic elastic scattering cross section of the Mott dephasings was calculated analytically. For this dephasing calculation the analytical forms of the atomic potentials given by Byatt were used. The total ionization and excitation cross sections were calculated with the Gryzinski model whose agreement with experimental results are good. For inelastic collisions the angular deflection distributions and the energy loss distributions were obtained by calibration of the Vriens cross sections. The initial energy of the incident electrons was 1,000 eV and these electrons and their secondary electrons were followed up to an energy equal to the first ionization potential of the moderator atoms. The first results obtained are presented. (tr-auth)

17443 (EUR-5122(Vol.2), pp 733-754) DISCUSSION ON THE VALIDITY OF CAVITY THEORIES AND A COMPARISON WITH EXPERIMENTAL RESULTS. Eggermont, G.; Janssens, A.; Jacobs, R.; Thielens, G. (Rijksuniversiteit, Ghent). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

A critical survey of cavity theories from Bragg-Gray to Burlin is presented. A recently published new theoretical approach is commented. It includes energy degradation, transmission and backscatter and introduces a modification to the Spencer–Attix energy deposition model. The easily computable Burlin expression with an adjusted attenuation coefficient fits stopping power ratios calculated from the new theory. A selection of experimental conditions is presented in order to investigate possible evidence for the β value. A discussion is given of several experimental data, including our own measurements, compared to theoretical calculations. (auth)

17444 (EUR-5122(Vol.2), pp 755-777) DOSIMETRIC STUDIES IN SPHERICAL CAVITIES PLACED IN A SEMI-INFINITE MILIEU AND IRRADIATED WITH 2-MeV ELECTRONS. Patau, J. P.; Malbert, M.; Terrissol, M.; Commanay, L. (Univ. Paul Sabatier, Toulouse). Mar 1974. (In French).

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

A computer simulation program for electron transport was developed for a system consisting of a semi-infinite medium in which there is a spherical cavity. The distribution of the electron source and its energy spectrum can be anything. An external monoenergetic irradiation with soft or bony tissue cavities was first considered. It is assumed that the ambient medium consists of the same bodies with all possible combinations. The diameter and the depth of the cavities can be varied at will. The results presents concern diameters varying from a micron to a millimeter. They furnish the energy deposits, the energy spectra of electrons entering and leaving the cavity, the statistical distribution of the energy deposit as a function of the LET and the specific energy distributions. (tr-auth)

17445 (EUR-5122(Vol.2), pp 779-798) TRANSITION FROM MULTIPLE SCATTERING TO COMPLETE DIFFUSION OF HIGH-ENERGY ELECTRONS. Roos, H.; Drepper, P.; Harder, D. (Univ., Wuerzburg, Ger.). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Angular distributions of high-energy electrons (E_0 from 5 to 20 MeV), after multiple scattering in various targets (Z from 6 to 82; d/r_0 from 0.1 to 1.1), are measured with a counter telescope in order to discriminate against target bremmstrahlung. The regularities obtained from the evaluation of half-value angles and mean square angles show the transition from thin-target multiple scattering to complete diffusion, with energy-loss and detour effects appearing in the intermediate region. The scaling law of electron absorption is confirmed in the high energy limit; the angular distributions are determined by the relative target thickness d/r_0 and the dimensionless parameter $Z \cdot m_0c^2/E_0$. Complete diffusion is not accomplished within the electron range for small values of the parameter $Z \cdot m_0c^2/E_0$. Angular distributions obtained with the Monte Carlo method are discussed in comparison to the experimental results. (auth)

17446 (EUR-5122(Vol.2), pp 855-868) ENERGY DEPOSITION SPECTRA FOR GAMMA-RAYS AND NEUTRONS IN TWIN VOLUMES. Benstock, D. M. J.; Burlin, T. E.; Simmons, J. A. (Polytechnic of Central London). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Previously, evidence was produced to indicate that for some radiobiological effects, damage must occur in two sites at least. Here an apparatus has been developed to study the energy deposition spectra in two volumes and the spectra obtained are presented and discussed. (MHR)

17447 (EUR-5122(Vol.2), pp 951-966) MEASUREMENT OF THE DOSE STRUCTURE AROUND SMALL RADIOACTIVE PARTICLES USING DISC DOSIMETERS. Bailey, M. R.; Harvey, J. R. (Central Electricity Generating Board, Berkeley, Eng.). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

As part of a research program concerned with the microdosimetric characteristics of radioactive particulates, attempts have been made to measure the dose structure around individual active particles in a solid tissue-like medium. Because of the microscopic scale of the dose resolution required, the measurement of the fine structure of dose around point sources of beta activity in solid media presents considerable technical problems. In the technique we are developing the radioactive particle is exposed on tightly packed stacks of thin LiF/teflon thermoluminescent disc dosimeters. Although each disc integrates dose over a range of distances, a simple mathematical manipulation of the data yields a curve of dose rate versus distance from the particle. Initial intercomparisons with theoretical estimates are encouraging. (auth)

17448 (EUR-5122(Vol.2), pp 983-1000) ENERGY DEPOSITION BY FAST NEUTRONS TO SMALL SPHERES. Booz, J.; Coppola, M. (EURATOM, Ispra, Italy). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

An empirical formula is presented that permits the calculation of $\bar{\epsilon}_F$, the flux averaged energy deposition, and $\bar{\epsilon}_D$, the dose averaged energy deposition by fast neutrons to small spheres. At first, $\bar{\epsilon}_F$ and $\bar{\epsilon}_D$ are calculated separately for the various recoil ions produced by monoenergetic neutrons. Then the average probability is calculated that a certain recoil ion will deposit some energy within the sphere and the average values of $\bar{\epsilon}_F$ and $\bar{\epsilon}_D$ for monoenergetic neutrons are derived. Finally, these results can be used for evaluating $\bar{\epsilon}_F$ and $\bar{\epsilon}_D$ of a given neutron spectrum. The results obtained have been controlled with our Monte-Carlo program ENSPHERE (Rad. res. 51, 551, 1972; Proc. 3rd Symp. Microdosimetry 511, 1972) for neutron energies of 50 keV to 6 MeV, for real diameters of 5.08 cm to 1.0 μm, and for the constant effective diameter of 1.0 μm. The discussion of the results deals especially with the accuracy of the simulation of small volumes with a Rossi-counter. (auth)

17449 (EUR-5122(Vol.2), pp 1001-1013) INFLUENCE OF DETECTOR SIZE AND THICKNESS ON NEUTRON PRODUCED ENERGY DEPOSITION SPECTRA. Coppola, M.; Pirrwitz, D.; Booz, J. (EURATOM, Ispra, Italy). Mar 1974.

From 4th symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

The shape of measured single event spectra produced by neutrons in macroscopic spheres equivalent to microscopic biological volumes can be influenced by the size and the geometrical characteristics of the measuring device itself. An investigation of the possible sources of alterations is necessary in view of both a correct simulation of the measurements by Monte-Carlo calculations and of an extrapolation of these results to very small volumes. The present work deals with the effects of charged particle energy straggling in the detector material and multiple scattering of neutrons in the sphere wall. The discussion is based on the comparison of spectra calculated with and without the inclusion of the effects under consideration. All calculations were done utilizing the Monte-Carlo program ENSPHERE 2. (auth)

17450 (GSF-S-150) CALCULATION OF THE ABSORPTION OF SOFT γ-RADIATION BY MEANS OF A MONTE CARLO METHOD. Gossrau, M.; Saebel, M. (Gesellschaft fuer Strahlen- und Umweltforschung G.m.b.H., Neuherberg/Muenchen (F.R. Germany). Inst. fuer Strahlenschutz). May 1971. 90p. (In German). INIS.

A general method is described which allows the calculation of the non-absorbed components of the incident components of the gamma energy applied within the energy range from 1 to 150 keV for a given geometry (cylinder, block) of an absorber (Cu, Ag, Ge, Pb, and Au). (INIS)

17451 (INIS-mf-911, pp 27-28) GENERAL MULTI-GROUP TIME MOMENTS METHOD FOR THE CALCULATION OF THE TIME DEPENDENT NEUTRON FLUX. Shvarts, D.; Thieberger, R.; Greenspan, E. (Israel Atomic Energy Commission, Beersheba). 1973.

From Israel Nuclear Society annual meeting; Yavne, Israel (26 Jun 1973).

This work suggests a general way of using time moments in constructing the time dependent neutron flux, which can be successful for a general system, including a multiplying one. (INIS)

17452 (LA-5598-MS) UNIFORM DEPTH–DOSE DISTRIBUTIONS FROM MONOENERGETIC NEGATIVE PION BEAMS. Meyer, H. O. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

Negative pions are attractive for cancer treatment because of a sharp enhancement of the deposited dose at the end of their range. The volume of interest has to be exposed to a uniform dose. The problem of using an inhomogeneous filter absorber to transform a monochromatic negative pion beam with a known dose deposition into a beam which causes a uniform depth dose within the treatment volume is investigated. Various shapes of absorbers are discussed. Dose deposition as a function of depth is treated analytically. The influence of beam divergence and multiple scattering is studied for various arrangements, and numerical sample calculations illustrate the importance of these effects. (auth)

17453 (LA-UR-74-897) MONTE CARLO CODE DEVELOPMENT IN LOS ALAMOS. Carter, L. L.; Cashwell, E. D.; Everett, C. J.; Forest, C. A.; Schrandt, R. G.; Taylor, W. M.; Thompson, W. L.; Turner, G. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 11p. (CONF-740710-2). Dep. NTIS $4.00.

From Monte Carlo conference; Argonne, Illinois, USA (1 Jul 1974).

The present status of Monte Carlo code development at Los Alamos Scientific Laboratory is discussed. A brief summary is given of several of the most important neutron, photon, and electron transport codes. (auth)

17454 (SZS-153, pp 239-246) SOME PROBLEMS OF THE DETERMINATION OF PLANNED SPECIAL EXPOSURES FOR WORKERS AND INDIVIDUAL MEMBERS OF THE PUBLIC. Musialowicz, T. (Zentrallaboratorium fuer Strahlenschutz, Warsaw). Aug 1973.

From 4th international symposium on personal dosimetry; Potsdam, F.R. Germany (10 Oct 1972).

National standards of radiation protection specify three categories of exposed individuals. For each category different maximum permissible doses are established. In practice sometimes difficulties arise in assigning persons to the right category. This concerns mainly the planning of exposure in accidental situations. Suggestions for planned exposure of workers and individual members of the public in non-typical situations are presented. (auth)

17455 (UCD-472-120, pp 34-39) SKYSHINE AND GROUND SCATTERING IN THE UCD-^{60}Co FIELD. Momeni, M. H.; Hinz, E. A.; Hogue, R. L. Jun 1973.

In annual report, fiscal year 1973.

The changes in the radiation environment in the ^{60}Co γ field were measured as a function of source–detector distance and angle with collimated and uncollimated NaI (Tl) detectors. The measurement of the ^{60}Co γ photopeaks at 0° deflection from the central beam axis, indicated a reduction in intensities, a broadening and finally absence with increasing distance from the source. The skyshine spectra, 90°, showed multiple peaks. (CH)

17456 (UCD-472-120, pp 40-44) MEASUREMENT OF THE EXPOSURE RATE AND BUILD-UP FACTOR OF ^{60}Co SOURCE WITH THERMOLUMINESCENT DOSIMETERS. Momeni, M. H.; Jow, N.; Bradley, E. W.; Rosenblatt, L. S. Jun 1973.

In annual report, fiscal year 1973.

The differential energy dependence of TLD-100 and TLD-200 ratios was utilized to measure the effective beam energy distribution and build-up in the UCD-^{60}Co field. The build-up was calculated from the measured beam intensity and a point photon source. The agreement between the beam intensity profile measured by TLD and a tissue-equivalent Victoreen chamber was good. The effective beam energy showed increasing beam degradation with distance from the ^{60}Co source. (5 figures) (auth)

17457 HALF-RANGE ORTHOGONALITY THEOREM FOR THERMAL–NEUTRON TRANSPORT. Ishiguro, Y. (Casade Univ., Sao Paulo, Brazil). Trans. Amer. Nucl. Soc.; 18: 148-149(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17458 LS_n OPERATOR METHOD IN TRANSPORT THEORY. Lee, C. E. (Los Alamos Scientific Lab., IL). Trans. Amer.. Nucl. Soc.; 18: 149-150(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17459 BRIEF SUMMARY OF A THEORY OF SELF-SHIELDING. Segev, M. (Soreq Nuclear Research Centre, Yavne, Israel). Trans. Amer. Nucl. Soc.; 18: 154-155(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17460 σ-AMBIGUITY IN THE METHOD OF SELF-SHIELDING FACTORS. Segev, M. (Soreq Nuclear Research Centre, Yavne, Israel). Trans. Amer. Nucl. Soc.; 18: 155-156(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17461 SIMPLE ALGORITHM TO CALCULATE THE IMMERSION DOSE. Normand, E.; Determan, W. R. (Sargent and Lundy, Chicago). Trans. Amer. Nucl. Soc.; 18: 358-359(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17462 RESOLUTION OF THE IMPORTANCE OF COHERENT–INCOHERENT SCATTERING IN PHOTON TRANSPORT IN AIR. Woolson, W. A. (Science Applications, Inc., Huntsville, AL); Scott, W. H. Jr.; Banks, N. E. Trans. Amer. Nucl. Soc.; 18: 374-376(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17463 ADJOINT MONTE CARLO CALCULATIONS OF INITIAL GAMMA RADIATION DOSES IN STRUCTURES. Beer, M.; Cohen, M. O. (Mathematical Applications Group, Inc., Elmsford, NY). Trans. Amer. Nucl. Soc.; 18: 377(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17464 CROSS-SECTION SENSITIVITY STUDY OF RADIATION TRANSPORT IN CONCRETE. Bartine, D. E.; Pace, J. V. III, Knight, J. R. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 18: 381-382(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17465 BODY MASS DISTRIBUTIONS FOR RADIATION DOSE ANALYSIS. Billings, M. P.; Yucker, W. R. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). Trans. Amer. Nucl. Soc.; 18: 396-397(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17466 DOSE LIMITS ASSOCIATED WITH NUCLEAR INSTALLATIONS. Winkler, B. C.; Simpson, D. M. (Atomic Energy Board, Pretoria). pp 590-600 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

In preparation for the introduction of nuclear power, the South African Atomic Energy Board, as licensing authority, is at present formulating its philosophy with respect to the licensing of nuclear installations. A proposed basic philosophy is discussed briefly and the proposed maximum permissible levels for operational purposes are discussed in some detail. (auth)

17467 SYNCHROTRON RADIATION AND ITS APPLICATIONS IN BIOLOGY. Holmes, K. C. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg). Endeavour; 33: No. 119, 60-66 (May 1974).

X-ray diffraction provides us with an insight into the mode of formation of biological macromolecules. Existing methods however suffer from the disadvantage of giving only a static view of what are essentially dynamic processes. The use of the extremely high intensity x-ray beams from electron synchrotrons and storage rings now enables this drawback to be overcome. The successful applications of synchrotron radiation in the biological field are given. (auth)

17468 ESTIMATION OF DOSE EQUIVALENT AND AVERAGE QUALITY FACTORS FOR π^- AND π^+ BEAMS. Wright, H. A.; Hamm, R. N.; Turner, J. E. (Oak Ridge National Lab., TN). Health Phys.; 27: No. 1, 3-8(Jul 1974).

A Monte Carlo computer program, used previously to compute absorbed dose as a function of position in a water phantom exposed to pion beams, is used to study dose equivalent and average quality factors. Detailed calculations for a typical beam (~6 cm diameter, 175 MeV/c mean momentum) of negative pions show that the average quality factor is 1.6 to a depth of about 16 cm, after which it rises to a maximum of 6.4 at a depth of 22 cm, some 2 cm beyond the depth at which the absorbed dose is maximum. Similar calculations for positive pions show that the quality factor decreases with depth, because of the decreasing cross section for nuclear interactions. Adding muons and electrons to the π^- beam changes only slightly the relative contributions made by heavy fragments (atomic mass number >1) and neutrons to the dose equivalent in the region where it is greatest. Average quality factors are also computed as a function of depth for π^- beams with mean momenta of 150 and 190 MeV/c. The maximum value of the average quality factor changes only slightly (from 5.5 to 7.0) over this momentum range. (auth)

17469 SIMPLE FORMULA FOR ESTIMATION OF SURFACE DOSE FROM PHOTONS EMITTED FROM A FINITE CLOUD. Chabot, G. E.; Skrable, K. W. (Lowell Technological Inst., MA). Health Phys.; 27: No. 1, 153-155(Jul 1974).

A model is presented to evaluate potential whole-body doses as a consequence of submersion in a finite cloud of radionuclides. The discussion does not account for the effects of the ground surface on the dose or the effects of confinement by solid walls and it only pertains to considerations of a tissue surface dose. (UK)

17470 DISTRIBUTIONS FOR THE DESIGN OF DOSIMETRIC EXPERIMENTS IN A TISSUE EQUIVALENT MEDIUM. Jones, T. D. (Oak Ridge National Lab., TN). Health Phys.; 27: No. 1, 87-96(Jul 1974).

In many neutron exposure situations, dose to soft tissue from either the $^{1}H(n,n)^{1}H$ or the $^{1}H(n,\gamma)^{2}H$ reaction accounts for ~90% of the total dose. The $^{14}N(n,p)^{14}C^{*}$ reaction accounts for most of the remaining dose for source energies below ~2.5 MeV, but for higher energies the remainder is usually divided among several different reactions. The whole body average contributions to dose from $^{1}H(n,\gamma)^{2}H$, $^{14}N(n,p)^{14}C^{*}$ and $^{1}H(n,n)^{1}H$ reactions in cylindrical tissue-equivalent phantoms corresponding in size to a rat, rabbit and man are given as functions of energy and results are also presented which show the dose contributions from the $^{1}H(n,\gamma)^{2}H$ reaction as functions of depth in each of the phantoms. LET spectral and dose distributions, corresponding to a lower neutron cutoff energy of 160 keV, are given for 14 MeV neutrons and for neutrons from the Health Physics Research Reactor (HPRR) having an energy spectral distribution similar to an unmoderated fission spectrum. The energy response threshold was chosen at 160 keV to coincide with that of the recoil proton proportional counter used to measure dose from neutrons. (auth)

17471 INELASTIC SCATTERING OF SLOW IONS IN CHANNELING. Kitagawa, M.; Ohtsuki, Y.H. (Department of Physics, Waseda University, Nishi-Ohkubo 4, Shinjuku, Tokyo, Japan). Phys. Rev. B 9: No. 11, 4719-4723 (1 June 1974).

The slow-ion channeling cases, the stopping power and diffusion coefficient for electronic excitations are calculated making use of the linear-response theory. The velocity dependence and electron-density dependence (or position dependence) are shown. The Firsov theory for the stopping power is reconfirmed, and we show that the diffusion coefficient does not depend on the ion velocity in the velocity range considered. (auth)

17472 ENERGY LOSS OF 1-10-MeV NITROGEN IONS IN ANTIMONY. Nakata, H. (Minamiuemachi, Kishiwada, Osada, Japan 596). Phys. Rev. B 9: No. 11, 4654-4659 (1 June 1974).

Stopping powers and ranges have been measured for 1-10-MeV nitrogen ions in antimony. Observed stopping powers in this energy region are not in agreement with theoretical predictions, whether the Z_1^3 correction term is included or not. The observed electronic stopping cross section is proportional to $E^{0.40}$, where E is the energy of nitrogen ions. These results are the same as had been observed in the previous experiment for N in Al, Ni, Se, Ag, and Au. The deviation of theory from experiment is partially due to the charge-changing phenomenon, Z_1 oscillation of the electronic stopping cross section, and the Thomas-Fermi model of the atom. (auth)

17473 WEIGHTED f-VALUES DETERMINED FROM SPECTRAL DISTRIBUTIONS. McDavid, W.D.; Waggener, R.G.; Levy, L.B.; Zanca, P. (Radiology Department, The University of Texas Health Science Center at San Antonio, San Antonio, Texas 78284). Med. Phys. 1: No. 1, 33-34 (May 1974).

Expressions provided by various authors for the weighted roentgens-to-rads conversion factor $\bar{f}$ are examined and compared. It is shown that f-values should be weighted by the relative exposure at each energy interval; $\bar{f}$ arrived at in this way is equivalent to the $\bar{f}$ obtained from the ratio of mass energy absorption coefficients weighted by energy fluence as described in ICRU Report 17. It is also equivalent to $\bar{f}$ as calculated directly as the ratio of relative total absorbed dose and relative total exposure. (auth)

17474 CORRECTION OF PERCENTAGE DEPTH DOSE FOR VARYING SSD FOR 8 MV x RAYS AND ^{60}Co GAMMA RAYS. Agarwal, S.K.; Wakley, J.; Scheele, R.V.; Howard, B.Y. (Department of Radiology (Radiological Physics), University of Virginia Medical Center, Charlottesville, Virginia 22901). Med. Phys. 1: No. 1, 29-32 (May 1974).

A change of source skin distance results in a significant change in percentage depth dose. The factors $P(f_2)/P(f_1)$ by which percentage depth dose at SSD f_1 is to be multiplied to find new percentage depth dose at SSD f_2 are tabulated and presented in a graphical form, for f_1 = 100 cm and f_2 = 110-140 cm for 8 MV x rays and for f_1 = 80 cm and f_2 = 90-140 cm for ^{60}Co gamma rays. The use of quadratic and linear equations to calculate this factor have been suggested. The ratios calculated using a quadratic equation agree very well with values from experimental data. (auth)

17475 IMPLICATIONS OF CAVITY CONSIDERATIONS ON THE ESTIMATION OF ABSORBED DOSE. Eggermont, G.; Janssens, A.; Jacobs, R.; Segaert, O.; Thielens, G. (Ghent Univ.). pp 49-63 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (Ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The relation between absorbed dose in a dosimeter, or cavity, and absorbed dose in the surrounding medium, is the subject of cavity theory. In this paper, a critical survey of the different theories that have been proposed, from that of Bragg-Gray to Burlin's general cavity theory, will be presented. The Burlin expression was evaluated using Tabata's range-energy relations and Page's stopping-power data. Calculations were performed at energies ranging from 10 keV to 3 MeV (X- and γ-rays), for LiF and $CaSO_4$ dosimeters in carbon, teflon, aluminium and copper media, and presented in graphs normalized to ^{60}Co γ-rays, for different dosimeter sizes. The comparison of experimental data with the theory for $CaSO_4$ grains in teflon proves the importance of the dosimeter size dependence on energy response. The Burlin theory by neglecting the effect of backscattering and energy-decrease of the electrons travelling through the cavity demonstrates the need for a more elaborate analytical expression. The backscattering contributions to absorbed dose may be very important for the calculation of dose in many diagnostic situations. Quantitative data are presented. A recently developed theory is explained. It includes all perturbation effects, such as backscattering and energy loss, but conserves the basic ideas of Spencer-Attix and follows a reasoning analogous to Burlin's. (auth)

17476 RADIATION DOSE CALCULATIONS AND MEASUREMENTS FOR THERAPY WITH A 4-MV LINEAR ACCELERATOR. Brodsky, A.; Kaplan, C.; Rogow, E.; Pavlicek, W. (Mercy Hospital, Pittsburgh). pp 72-97 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (Ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Methods of calculation and measurement of patient radiation doses from a 4 MV CLINAC linear accelerator, developed during the first year of therapy, are presented. Initial cavity ion chamber measurements of tissue/air ratios, depth-dose percentages, and other parameters agreed within 1% with the data of Petersen and Golden. Appropriate calculation procedures were then developed to provide machine console settings in "RADS" (here called monitor units, "M.U.") to deliver accurate patient dosage. Patient dosage measurements in vivo and in phantoms have shown that the methods of patient calculation are accurate within a few percent and consistent with the data of Petersen and Golden for the variety of patient treatment configurations. Agreement between machine M.U. settings and absolute calibration measurements of reference fields, and the precision and repeatability of dose delivery by the CLINAC also indicate that the methods presented may be useful as a check and/or aid to establishing dosimetric methods in other linear accelerator installations. Equations for dose calculations are included. (auth)

17477 PROBLEMS IN THE FIELD OF NEUTRON DOSIMETRY FOR HEALTH PHYSICS PURPOSES. Nachtigall, D. (Paedagogische Hochschule Ruhr, Dortmund, Ger.). pp 151-170 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige, Y. (Ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

The dose equivalent H is the most important quantity in the field of neutron dosimetry for health physics purposes. It is given by $H = \int D_L Q(L) dL$, where D is the absorbed dose, L the linear energy transfer, Q(L) the quality factor and $D_L = dD/dL$. Using relations between the absorbed dose D and the neutron fluence ϕ, this becomes $H = \int \phi_E f(E) dE$, where E is the neutron energy, f(E) a conversion function and $\phi_E = d\phi/dE$. All known methods for the determination of H, when applied to neutron fields of unknown spectral distribution, are unsatisfactory. One is faced with four main difficulties: (1) Conceptual disagreements in connection with the choice of Q(L) and f(E). (2) Unknown response curves of instruments for the direct determination of H (rem counters). (3) Difficulties with devices for the measurement of D and Q(L). (4) Uncertainties in measured ϕ-values. These four difficulties are discussed. (auth)

17478 INFLUENCE OF THE SHELL STRUCTURE OF THE ABSORBER ATOM ON THE MASS ATTENUATION COEFFICIENT OF A SOLID FOR β RADIATION. I. Contribution of the Scattering to the Shielded Nuclear Field. Thuemmel, H. W. (Zentralin-

stitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 10: No. 1, 20-23(Jan 1974). (In German).

An attempt was made to determine how far the empirically found periodicity in the $\mu^*(Z)$ dependence could be made to agree with the known regularities in the interaction of fast electrons with matter. A qualitative evaluation of the theoretical study showed that the pattern of the left branch of $H_{rel}(Z)$, the shell influence factor, can often be understood on the basis of the electron scattering on the shielded nuclear field whereas for the right side the electron slowing down appears to be the determining factor. (JSR)

17479 INFLUENCE OF THE SHELL STRUCTURE OF THE ABSORBER ATOM ON THE MASS ATTENUATION COEFFICIENT OF A SOLID FOR β RADIATION. II. Contribution of the Slowing Down. Thuemmel, H. W. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 10: No. 1, 23-25 (Jan 1974). (In German).

The contribution of the slowing down to the effect of the shell structure on the mass attenuation coefficient is analyzed on the basis of theoretical considerations and experimental results. It is shown that the period-dependent structures in the nuclear charge number dependence of the mass attenuation coefficient of solids can be understood qualitatively on the basis of theoretically and experimentally known phenomena of the interaction of charged particles with matter. (JSR)

17480 INFLUENCE OF NATURAL BONES ON THE DOSE DISTRIBUTION OF ELECTRONS AND PHOTONS UP TO 42 MeV. Fehrentz, D.; Schroeder-Babo, P.; Canzler, R.; Poser, H. (Heidelberg Univ., Mannheim, Ger.). Strahlentherapie; 146: No. 6, 644-656(Dec 1973). (In German).

On natural bones, embedded in muscle-equivalent material, and on bovine compact substance plates of 4 × 4 cm size and a total thickness of 3.7 cm, ionometric and film-dosimetric tests were performed under ^{60}Co-gamma-radiation, 42 MV x-rays and electrons between 4.2 and 42 MeV. The largest dose-increase in compact substance amounted to 8 p.c. under 42-MV x-rays, and 20, 17, 4 and 5 p.c. under electrons of 4.2, 10, 25 and 42 MeV. On the lateral, smooth margin of the plates under electron irradiation dose alterations up to 20 p.c. were observed, on natural bones however up to 5 p.c. only. The skull bones and the diaphyses of the long bones of the extremities have an average density of about 1.6 g/ccm, all the other bones, in particular those in the trunk and the joints, of about 1.2 g/ccm. Therefore, the dose distributions behind the bones under electron irradiation can mostly be described with sufficient accuracy by shifting of the water depth-dose-curves for 20 p.c. of the perradiated bone-layer thickness in direction to the surface. (GE)

17481 COMITE CONSULTATIF POUR LES ETALONS DE MESURE DES RAYONNEMENTS IONISANTS. Section I. Rayons x et γ, Electrons. (Consulting Committee for Measurement Standards of Ionizing Radiations. Section I. X and γ Electrons). Sevres, France; Bureau International des Poids et Mesures (1972). 47p.

Members reported current or planned projects on exposure standards and measurements of absorbed dose. Comparisons of exposure standards made since 1970 are reported and the management of periodic comparisons of these standards is adopted. Radiation qualities in radiation therapy and radiation protection are recommended. A humidity correction for ionization chambers is proposed. The preparation of international comparisons of absorbed dose standards for ^{60}Co radiation is described. The principal conclusions reached are summarized. (JSR)

Radiation Protection Standards

Refer also to abstracts 15868, 15899, 16018, and 18037.

17482 CONSIDERATIONS REGARDING AUTHORIZATION OF THE USE OF RADIOACTIVE DEVICES BY THE PUBLIC. Rosental, N.; Feige, Y.; Schlesinger, T. (Soreq Nuclear Research Centre, Yavne, Israel). pp 618-628 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The use of devices and instruments containing various radioactive materials by the public has become widely spread during recent years. The existing legislation concerning such devices is still incomplete in two aspects: (a) legislation does not cover all types of devices; (b) there are significant discrepancies among some of the national standards adopted. Safety standards proposed in Israel for the authorization of use by the public of devices and instruments containing radioactive materials, such as smoke detectors, beta lights containing tritium gas, etc. are presented. The safe handling and storage of these items in relation to maximum permissible exposures to members of the public are discussed. (auth)

17483 STATUTORY CONTROL OVER THE USE OF RADIOACTIVE MATERIALS IN SOUTH AFRICA. Selzer, A.; Basson, J. K. (Atomic Energy Board, Pelindaba, South Africa). pp 629-640 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

Control over the use of radioactive material is vested in the Atomic Energy Board by virtue of the provisions of the Atomic Energy Act of 1967. Control is exercised by registration of all users (medical as well as nonmedical) of radioactive materials, and authorities to use such materials are issued subject to a number of conditions (regulations) the purpose of which is to ensure radiation safety. It is the policy of the Board to have the minimum of regulations and to keep them as uncomplicated as possible. Control over compliance with the Board's conditions is carried out by means of routine inspections by physicists. At the end of 1972 there were 277 nonmedical and 50 medical users of radioactive material in South Africa. The nonmedical users are mainly the manufacturing industry and the mines, where radioactive sources are used for quality control and automation processes, while the medical users range from pathological laboratories, where only microcurie amounts of a radionuclide is used, through the medical practitioners in private practice, to the training hospitals where extensive use is made for diagnostic as well as therapeutic purposes. As a result of problems that were experienced in the field of industrial radiography, special measures had to be taken, viz., the limiting of the activity of radiography sources according to handling facilities and special training, and individual registration of industrial radiographers. In the medical field special training and qualifications are also required, although, in the case of the training hospitals, general authorities for the use of radioactive materials are granted provided certain requirements are met. Appliances such as antistatic brushes, smoke detectors and luminous signs, over which strict control is regarded as superfluous, have been exempted to a large extent. (auth)

17484 SI UNITS FOR IONIZING RADIATIONS. Allisy, A. (CNAM, Paris). J. Belge Radiol.; 57: No. 1, 23-28(1974). (In French).

The present positions of the Comité International des Poids et Mesures and the International Commission on Radiation Units and Measurements regarding the use of the International System of Units (SI) are given. Physical quantities and units are briefly considered with special reference to coherence. A few simple rules are given concerning the symbols and units. (auth)

Radiation Source Calibration and Standardization

17485 INFLUENCE OF CONDUCTIVITY OF THIN GOLD FILMS ON THE STANDARDIZATION OF RADIONUCLIDES. Moura, L. P.; Parker, W. C. (Cidade Univ., Sao Paulo, Brazil). Trans. Amer. Nucl. Soc.; 18: 72-75(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17486 SPECIFICATION OF UNITS FOR NATURAL URANIUM AND NATURAL THEORUM. Ney, W.R. (7910 Woodmont Ave.,Suite 1016, Washington, DC 20014). Med. Phys. 1: No. 1, 36-36 (May 1974).

The radiation dose units for natural uranium and natural thorium as specified by the national council on radiation protection and measurements are discussed. (AIP)

17487 REDUCED OUTPUT OF ORTHOVOLTAGE RADIOTHERAPY UNITS: THREE CASE REPORTS. Kennely, E.V. (Hospital of Saint Raphael, New Haven, Connecticut 06511). Med. Phys. 1: No. 1, 35-35 (May 1974).

On three separate occasions, calibrations of radiotherapy orthovoltage units disclosed considerably reduced useful beam intensities without any apparent alteration of the tube current or tube voltage. These reductions would have been undetected by routine daily operation of the equipment unless a useful beam intensity monitoring unit were installed at the tube port or daily measurements were made of the useful beam intensity with calibrating instruments. Either or both monitoring methods are recommended for all radiotherapy units. (auth)

17488 MEASUREMENTS FOR RADIATION SAFETY. Wyckoff, J. M. (National Bureau of Standards, Washington, DC). pp 130-135 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

The safety of the population in relation to a wide variety of radiations depends upon the accurate measurement of these radiations. The role of the National Bureau of Standards in these measurements is reviewed. The variety of radiations involved include x rays, nuclides, ultraviolet, laser, electromagnetic, and ultrasonic radiation. The activities at the National Bureau of Standards supports the establishment of radiation safety standards by various regulatory agencies. (ERB)

Shielding Calculations and Experiments

Refer also to abstracts 15284, 17298–17302, 17329, 17330, 17436, 17437, 17572, 17682, 17789, 17898, 17901, and 17930–17933.

17489 (CONF-721018-(Vol. 1), pp 215-225) RADIATION SHIELDING INFORMATION CENTER (RSIC). A Unifying Force in the International Shielding Community. Maskewitz, B. F.; Trubey, D. K.; Roussin, R. W.; Clark, F. H. (Oak Ridge National Lab., TN). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The Radiation Shielding Information Center is a technical institute serving the international shielding community. It acquires, selects, stores, retrieves, evaluates, analyzes, synthesizes and disseminates information on shielding and ionizing radiation transport. Computer codes and computer-readable nuclear data are treated as an integral part of this work. Problems which hinder code exchange are alleviated by scientists making new development available and therefore open to scrutiny and improvement. Through free and open exchange of shielding information the entire international shielding community can progress rapidly as a unit to advance the state of the art. 26 references. (auth)

17490 (CONF-721018-(Vol.1), pp 226-233) ESIS: EUROPEAN SHIELDING INFORMATION SERVICE. Nicks, R.; Ponti, C. (EURATOM-CCR, Ispra, Italy). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

ESIS is a new analysis and information center on shielding. It was organized at the beginning of 1972 at the Joint Research Center of Ispra (Italy). The reasons that have led to the creation of this information center and its program are described. (auth)

17491 (CONF-721018-(Vol.2)) PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON REACTOR SHIELDING, PARIS, FRANCE, OCTOBER 9–13, 1972. Volume 2. (Organization for Economic Co-Operation and Development, 75–Paris (France); CEA, 75–Paris (France)). 1972. 390p. (In Several Languages).

Separate abstracts are prepared for each of the 18 papers presented. (CES)

For abstracts of individual papers see: 17298–17301, 17436, 17437, 17492–17499, 17682, 17789, 17931, and 17932.

17492 (CONF-721018-(Vol.2), pp 253-267) APPLICATIONS OF THE TRANSMISSION MATRIX METHOD IN GAMMA RAY SHIELDING ANALYSIS. Rohach, A. F. (Iowa State Univ., Ames). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The transmission matrix method has been applied to various gamma ray shielding problems. The transmission matrix from plane geometry analysis has been used to develop a point geometry matrix kernel. The point kernel has been investigated for shielding slabs of two or more materials. Various types of shielding configuration using surface sources, volumetric sources, and exponential secondary sources also have been investigated. Results have been compared with previous published works and other computations using scalar point kernel and buildup factor analyses. (auth)

17493 (CONF-721018-(Vol.2), pp 442-455) INTERACTIVE COMPUTER GRAPHICS APPLIED TO SHIELD DESIGN. Goddard, A. J. H.; Wrigley, M. F. (Imperial Coll. of Science and Tech., London). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A study is reported of the use of interactive computing techniques, together with the use of a visual display unit, in shield design. The particular application is to the design of cells containing gamma sources. Experimental measurements are also reported which were made in a cell/labyrinth configuration with the object of evaluating the model used to represent gamma streaming. (auth)

17494 (CONF-721018-(Vol.2), pp 456-470) SHIELDING OPTIMIZATION BY DIFFERENTIAL DYNAMIC PROGRAMING METHOD AND EXPERIMENT. Kanai, Y. (Ship Research Inst., Tokyo); Yamaji, A.; Takeuchi, K. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Differential dynamic programing method is presented to determine the optimum shield system by minimizing a performance criterion, which is represented as a linear combination of three functions with respect to weight, cost, and thickness or dose, subject to certain constraints. A linear differential approximation is applied to the calculation of radiation attenuation, with 7 groups for both neutrons and gamma rays. The theoretical and experimental determination of the optimal configuration for a laminated iron-water shield are attempted. (auth)

17495 (CONF-721018-(Vol.2), pp 488-500) SPATIAL, ENERGY, AND ANGULAR DISTRIBUTIONS OF RADIATIONS IN REACTOR SHIELDING. Abagyan, A. A.; Bass, L. P.; Germogenova, T. A. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The characteristics of programs for the calculation of radiation fluxes by the method of discrete ordinates in plane one-dimensional and axisymmetric two-dimensional geometries are given. The calculation and experimental results for a wide range of shielding materials are compared. A description is given of an appropriate method for the experimental study of fast-neutron fields. (auth)

17496 (CONF-721018-(Vol.2), pp 501-537) MODIFIED FORM OF DIFFUSION THEORY FOR USE IN CALCULATING NEUTRON PENETRATION IN PRACTICAL SHIELDS. Bendall, D. E. (Atomic Energy Establishment, Winfrith, Eng.); Cripps, S. J. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A rapid survey method for bulk shield analysis is proposed as an alternative to the well-known neutron removal-diffusion method. Two variants are described, one using the multigroup diffusion equations with a true first flight correction, and the other using the multigroup equations alone; this latter form without the kernel integration offers worthwhile savings in computer costs. A feature of the method is the adjustment of the diffusion coefficients so that very close agreement is achieved with Monte Carlo reference calculations for simple one dimensional slabs. A series of tests confirming the validity of the use of the adjusted parameters in more general shielding situations is described. The application to gamma shielding is also considered. (auth)

17497 (CONF-721018-(Vol.2), pp 557-578) CHARACTERISTICS OF SECONDARY GAMMA RADIATION FROM THE HEAVY COMPONENT OF NUCLEAR REACTOR SHIELDING. Abagyan, A. A.; Vrazhnov, Yu. N.; Germogenova, T. A.; Degtyarev, S. F.; Dubinin, A. A.; Zhuravlev, V. I.; Kazanskii, Yu. A.; Utkin, V. A. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The characteristics of secondary gamma emission resulting from neutron capture and inelastic scattering in various shielding materials are discussed. In order to obtain a detailed picture of the characteristics of secondary gamma emission, a combined system of transport equations for neutrons and gamma quanta is solved by the method of discrete ordinates. Correlations are investigated between neutron and gamma-quanta doses as a function of shielding thickness, spectrum and neutron angular distribution, etc. A comparison with the experimental results is presented. (auth)

17498 (CONF-721018-(Vol.2), pp 579-595) APPLICATION OF THE INVARIANT IMBEDDING METHOD TO THE PENETRATION PROBLEMS OF NEUTRONS. Nakai, M. (NAIG Nuclear Research Lab., Kawasaki, Japan); Komatsu, I.; Sato, Y.; Noguchi, F.; Shimizu, A.; Hada, M. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A one-dimensional neutron penetration calculation code, SLDN, has been developed. In the code, the penetration of fast neutrons is solved by the invariant imbedding method and the penetration of intermediate and slow neutrons is solved by the diffusion ap-

proximation method. Calculation of neutrons penetrating the multilayer shield was performed with 30 group shielding constants generated from ENDF/B-I. The results were in good agreement with the results by the ANISN code for the corresponding geometry and the computing time was much less than that of the ANISN. The results were also in good agreement with measurements. (auth)

17499 (CONF-721018-(Vol.2), pp 596-610) LINE OF SIGHT ATTENUATION OF PARTICLES PROCESSED BY A MONTE CARLO METHOD: MERCURE-4 THREE-DIMENSIONAL PROGRAM. Devillers, C.; Dupont, C. (CEA, Fontenay-aux-Roses, France). 1972. (In French).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The program MERCURE-4 integrates neutron or gamma-ray line of sight point attenuation kernels (biological doses, gamma-heating, ...) by a Monte-Carlo technique in three-dimensional geometrical configurations and in the multigroup approximation. The program calculates and adjusts itself for importance values which it uses for sampling source particles so that the effort of the user not familiar with Monte-Carlo is reduced to a minimum. (auth)

17500 (CONF-721018-(Vol.3), pp 937-952) INVESTIGATIONS INTO THE GAMMA-RAY ATTENUATION IN CONCRETE SHIELDING WITH PIPES. Futtermenger, W. (Technische Univ., Hanover). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The influence of void effects and streaming on gamma attenuation in concrete walls with built-in bundles of pipes was investigated with reference to the conditions in a fuel reprocessing plant. An infinite plane source was assumed with an angular distribution and spectrum corresponding to those at the surface of volume sources. The dose rates were calculated for straight and double staggered pipes. These calculations lead to the determination of conditions under which the use of double staggered pipes and heavy concretes is necessary. (auth)

17501 (CONF-721018-(Vol.3), pp 953-972) RECENT METHODS FOR TESTING GAMMA SHIELDS. Fourcade-Cancelle, N.; Papot, L. (CEA, Saclay, France). 1972. (In French).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The shielding materials used are well known, but their efficiency may be reduced by some possibly imperfect construction. This efficiency is to be checked by testing; for this purpose, one will use well calibrated gamma sources and detectors of various type. From the measured dose rates, the shield is amended to bring its efficiency up to normal values. Sponsored by I.A.E.A. and AFNOR (French Standard Organization), an experimental work was performed by the C.E.A. in order to propose precise acceptance criterions, based on the actual consequences the defect may have for the staff. (auth)

17502 (CONF-721018-(Vol.3), pp 996-1008) COMPARISON OF DINE NEUTRON ATTENUATION CALCULATIONS WITH EXPERIMENTAL RESULTS FOR A WIDE VARIETY OF SIMULATED CONCRETE CONFIGURATIONS FOR A FAST AND THERMAL REACTOR SPECTRUM. Verschuur, K. A. (Reactor Centrum Nederland, Petten). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

In the small shielding facility KAF measurements have been done in 86 cm of iron and in simulated concrete configurations of about 66 cm thickness, with and without an iron filter to simulate a fast reactor spectrum. These measurements have been used to test the neutron shielding program DINE for the first part of a reactor shield. DINE is a removal-diffusion code with multigroup difference equations developed to give an improvement in the calculation of the deep penetration of diffusing neutrons. To demonstrate the improvement by this method calculations have been done also with a version of DINE using ordinary diffusion theory. (auth)

17503 (CONF-721018-(Vol.3), pp 1009-1025) APPLICATION OF REMOVAL-DIFFUSION METHODS TO REACTOR SHIELDING PROBLEMS. Herrnberger, V. (Swiss Federal Inst. for Reactor Research, Wuerenlingen); Tai, A. S.; Zuber, J. F. 1972. (In French).

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The computer program MAC-RAD and SABINE, based on the removal-diffusion methods were applied to: (1) the lay out of an inner shield of given thickness and two componets (iron/moderator) with regard to various dose rates by changing the type, the content and the distribution of moderator (C, B_4C, D_2O, H_2O, TiH, ZrH), and (2) the calculation of the dose rates about the biological shield of a critical assembly for the purpose of comparing the two methods and verifying available measurements. (auth)

17504 (CONF-721018-(Vol. 3), pp 1166-1179) STUDY ON SHIELDING EFFECT OF GAMMA RAYS BY SHIP STRUCTURES. Ueki, K.; Yamakoshi, H.; Nakata, M. (Ship Research Inst., Tokyo). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

From the view point that compartment structure of ship is composed of finite-sized iron slabs with various shapes and sizes, an empirical formula is proposed for estimation of dependence of Energy Buildup Factor for finite sized iron slab on positions of γ-ray source and detector in relation to the iron slab, energy of source γ rays, geometry of the iron slab. A synthesis formula is also proposed for prediction of Energy Buildup Factor for γ rays at arbitrary position within a compartment structure, in terms of geometry of the structure and the Energy Buildup Factor for each finite sized iron slab. Predicted Energy Buildup Factors by ordinary calculation methods as well as the proposed method are compared with experimental results for a model of compartment structure to show that the proposed method improves the prediction by taking account of shielding effect by compartment structure for γ rays. The proposed method is applied to analyze dose distribution of γ rays in a training ship "Shintoku Maru" to show that the proposed method works well. (auth)

17505 (IA-1295) PARAMETRIC REPRESENTATION OF THE SHIELDING FACTOR CURVES. Gur, Y.; Yiftah, S. (Israel Atomic Energy Commission, Tel Aviv). Jan 1974. 42p. Dep. NTIS (US Sales Only) $5.25.

Two new methods for a parametric representation of the temperature dependent self-shielding factor curve are given. The concept of the self-shielding factor is described in detail and current conventional methods of interpolation between two tabulated values of the shielding factor curve are reviewed. Two methods for the parametric representation of the curve are suggested. Of the two, one is found to fit the data very well. A complete list of parameters for the temperature dependent self-shielding factor curves, using the better method, is given for U-235, U-238, Pu-239, Pu-240, Pu-241, and Pu-242. (auth)

17506 (ORNL-RSIC-5(Vol.4)) BIBLIOGRAPHY, SUBJECT INDEX, AND AUTHOR INDEX OF THE LITERATURE EXAMINED BY THE RADIATION SHIELDING INFORMATION CENTER (REACTOR AND WEAPONS RADIATION SHIELDING). Gurney, J.; Gustin, A. B. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 554p. Dep. NTIS $13.60.

An indexed bibliography is presented of literature selected by the Radiation Shielding Information Center since the previous volume was published in 1971 in the area of radiation transport and shielding against radiation from nuclear reactors, x-ray machines, radioisotopes, nuclear weapons (including fallout), and low energy accelerators (neutron generators). The bibliography was printed by computer from magnetic tape files. In addition to lists of literature titles by subject categories (accessions 2301-3500), author and key-word indexes are given for the entire file, which includes citations listed in the previous volumes (I–III). Most of the literature selected for Vol. IV was published in the years 1971–1973. (auth)

17507 (ORNL-tr-2831) LGH–G: A PROGRAM FOR THE CALCULATION OF GAMMA RADIATION THROUGH PARTIALLY SHIELDED GAPS. Fiebig, R.; Rybaczok, P. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m. b. H., Hamburg (F. R. Germany)). 1973. Translation by E. J. Zuckerman of GKSS–73/E/17. 50p. Dep. NTIS $5.50.

The LGH–G program calculates gamma-ray distribution for single energies and single points between two shielding layers in which there is a perforation. The perforation may be in each of the two layers, appearing from the source. The buildup-factor method is applied in Taylor approximation. (auth)

17508 (SZS-153, pp 117-136) SPECTRA AND DOSE FRACTIONS OF MONOENERGETIC NEUTRONS PASSED THROUGH DIFFERENT SHIELDS AND THEIR APPLICATION FOR DOSEMETER EVALUATION. Maskra, S.; Palfalvi, J.; Vertes, P. (Central Research Inst. for Physics, Budapest). Aug 1973.

From fourth international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Leakage neutron spectra for monoenergetic sources and for slab shields of different compositions and thicknesses are calculated. Source energies ranging from 0.34 keV to 10.5 MeV are considered for the following shielding materials: water, concrete, boron-loaded polythene and iron at thicknesses ranging from 5 to 60 cm. Readings of several dosimeters are determined, making use of the spectra; the measured percentages of

the dose equivalent are evaluated for the following devices: thermal neutron detectors, Harvey albedo dosimeters, Yeshida-Dennis proportional counters, Dennis-Loosemore counters, nuclear emulsions, and proton-recoil scintillation counters. Dosimeter reading calculations are extended up to 15 MeV energy, which is of great practical importance for (d,t) neutron generator monitoring. Finally recommendations are given concerning the selection of dosimeters for different monoenergetic neutron sources with different shieldings. (auth)

17509 (SZS-153, pp 166-179) NEUTRON LEAKAGE SPECTRA CALCULATIONS AND THEIR APPLICATION IN NUCLEAR ACCIDENT DOSIMETRY. Makra, S. (Central Research Inst. for Physics, Budapest). Aug 1973.

From fourth international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Spectra of neutrons which passed through different shielding walls were calculated. Such leakage spectra were determined for the following cases: fission and reactor sources and shielding walls of water, polyethylene, concrete, aluminium, beryllium, iron and several mixtures of these materials. Calculated spectra are compared with literature data and used for dosimeter evaluation. Recommendations are given concerning the use of different personnel and nuclear accident dosimeters. (auth)

17510 ADDITIONAL FEW-GROUP AND MULTIGROUP CALCULATIONS OF NEUTRON PENETRATION. Shure, K. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 18: 367-368(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17511 FISSION NEUTRON STREAMING. Barrett, M. J. (Analytic Products, Inc., Bethesda, MD); Duffey, D. Trans. Amer. Nucl. Soc.; 18: 371-372(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17512 APPROXIMATE PROCEDURES FOR CALCULATING PROTECTION FROM INITIAL GAMMA RADIATION. Eisenhauer, C. M.; Spencer, L. V. (National Bureau of Standards, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 378(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17513 ONE-DIMENSIONAL CALCULATIONAL METHOD FOR AN AIR-OVER-GROUND RADIATION FIELD INCIDENT ON AN UNDERGROUND CONCRETE STRUCTURE. Pace, J. V. III (Union Carbide Corp., Oak Ridge, TN); Mynatt, F. R. Trans. Amer. Nucl. Soc.; 18: 379(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17514 RADIATION TRANSPORT STUDIES FOR BURIED CONCRETE STRUCTURES. Ziskind, R. A. (TRW Systems, Redondo Beach, CA); Gordon, J. D.; Allen, C. S. Trans. Amer. Nucl. Soc.; 18: 379-380(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17515 TRANSMISSION OF GAMMA RADIATION THROUGH DUCTS IN CONCRETE WALLS. Patti, F. J.; Sullivan, R. E.; Bresticker, S.; Savin, N. L. (Burns and Roe, Hempstead, NY). Trans. Amer. Nucl. Soc.; 18: 382-383(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17516 INFINITE-MEDIUM BUILDUP FACTORS INCLUDING THE CONTRIBUTION OF BREMSSTRAHLUNG. Tsoulfanidis, N. (Univ. of Missouri, Rolla). Trans. Amer. Nucl. Soc.; 18: 394-395(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17517 SIMPLIFIED ANALYSIS OF ONE- AND TWO-DIMENSIONAL THIN SHIELD PROBLEMS. Forbes, I. A.; Beghian, L. E. (Lowell Technological Inst., MA). Trans. Amer. Nucl. Soc.; 18: 399-400(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17518 CALCULATION OF NEUTRON ANGULAR DISTRIBUTION AND ENERGY SPECTRUM FOR VARIOUS SPATIAL DIRECTIONS IN THE VICINITY OF IRON SHIELDS. Doerschel, B. (Technische Univ., Dresden). Kernenergie; 17: No. 4, 117-121(Apr 1974). (In German).

The angular distribution of neutrons in front of and past iron shields of various thicknesses is determined for parallel and isotropic incidence of the primary neutrons. The energy spectra of transmitted and reflected neutrons are given for various directions of scattering. The results obtained by means of the Monte Carlo method show that both angular distribution of the primary neutrons and the thickness of iron layer essentially affect the neutron field in the vicinity of the iron shields. The exit spectrum of VVR-S reactor neutrons has been taken as the primary energy spectrum. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstract 17529.

17519 SOME CONSEQUENCES OF THE STRENGTHENED INTERPRETATIVE RULES OF QUANTUM MECHANICS. Benioff, P. (Argonne National Lab., IL). J. Math. Phys. (N.Y.); 15: No. 5, 552-559(May 1974).

Some consequences of the strengthened interpretative rules of quantum mechanics, which were proposed earlier, are obtained. It is also seen that, in general, the usual interpretative rules are too weak to obtain these results. For example, it is proved from the strengthened rules that if f:R → R is a Borel function which is also τ-definable, then for each observable A the procedure "measure A and compute f(A outcome)" is an f(A) measurement procedure. It is also shown that there exist Borel f and observables A such that the above procedure is not an f(A) measurement procedure. Two methods of measuring the sum A + B of two observables are then considered: The measurement of A and B on different systems followed by addition of the results and (if A and B commute) the simultaneous measurement of A and B on the same system followed by addition. It is proved from the strengthened rules that the first method is not a valid measurement procedure and the second is valid. Besides these, other processes such as procedures for preparing mixtures of different states, and the empirical generation of probability measures from outcome sequences are considered. (auth)

17520 LIMIT OF THE MOST DEGENERATE REPRESENTATIONS OF SO(p,1). Ardalan, F. (Arya-Mehr Univ. of Tech., Teheran). J. Math. Phys. (N.Y.); 15: No. 5, 625-630(May 1974).

The limit of the group SO(p,1), for large Lorentz transformations, are studied. It is found that the basis functions of the most degenerate representations of SO(p,1), constructed according to the subgroups SO(p) and SO(p − 1,1), asymptotically tend to the basis functions, constructed according to the corresponding contracted subgroups. This result is applied to the matrix elements of SO(p,1) to derive novel relations. The limit of the overlap functions are considered. (auth)

17521 DYNAMICAL GROUPS: CLASSIFICATION OF LIE ALGEBRAS WITH GALILEI SUBALGEBRAS. Doebner, H. D.; Hennig, J. (International Centre for Theoretical Physics, Trieste, Italy). J. Math. Phys. (N. Y.); 15: No. 5, 602-608(May 1974).

Because of the pure group theoretical approach to the free nonrelativistic particle through an integrable irreducible representation of the quantum mechanical Galilei (Lie) algebra G, it is reasonable to construct so-called dynamical (Lie) algebras D which possess an integrable representation describing interacting (nonrelativistic) systems. Such dynamical algebras D should contain the geometrical subalgebra G_0 of G, spanned by the mass operator, the momentum, the angular-momentum and the position operators. Furthermore, the relation between the free and the interacting system is simplified if the one-dimensional Lie algebra T generating free time translations is a subalgebra of D. Hence preferred candidates for D are those Lie algebras L which possess a subalgebra isomorphic to G or to G_0, i.e., those L for which an injective homomorphism ϵ: G → ϵ(G) ⊂ L or G_0 → $\epsilon(G_0)$ ⊂ L exists. ϵ is called an embedding of G or of G_0 in L. Our main result is a complete classification of all nonsemisimple L with Levi decomposition L = S ⊂ F with G or G_0 embedding ϵ such that S ⊂ ϵ(G) or S ⊂ $\epsilon(G_0)$, all complex semisimple $\overline{L}$ with an embedding of the complex extension of G, all real simple L being real forms or realifications of the lowest dimensional $\overline{L}$ (i.e., A_1, B_2, C_4) with G-embedding. The result gives a fairly complete list of all candidates for dynamical nonrelativistic algebras. The physical aspects of two of them, the conformal Galilei algebra G_c and a limitable dynamical algebra D^t, are discussed. A method for the construction of physically useful integrable representations for G_c and D^t is given. Some general properties of nonrelativistic and of relativistic dynamical algebras with G-embeddings are considered. (auth)

17522 STATISTICAL MECHANICAL THEORY OF METASTABLE STATES. Sewell, G. L. (Queen Mary Coll., London). Lett. Nuovo Cim.; 10: No. 10, 430-434(6 Jul 1974).

An approach to general rigorous microscopic theory of metastable states in classical systems is proposed. (JFP)

17523 CONVERGENCE PROOF FOR THE KOHN VARIATIONAL METHOD. Singh, S. R.; Stauffer, A. D. (York Univ., Downsview, Ont.). Lett. Nuovo Cim.; 10: No. 10, 401-404(6 Jul 1974).

A previous modification of the Kohn variational method is shown to be unnecessary. The original Kohn method yields a convergent process to determine t. Also the present formulation removes the restriction of U being of a definite sign which was implicitly assumed in previous work. (JFP)

17524 CLASSIFICATION ACCORDING TO INTERNAL SYMMETRIES IN THE QUANTUM-MECHANICAL MANY-BODY-PROBLEM. P. 1. General Analysis to the Many-Body-Problem in Reduced Coordinates. Wunner, G.; Ruder, H.; Volz, H. (Erlangen-Nuernberg Univ., Erlangen (F.R. Germany). Inst. fuer Theoretische Physik). Z. Phys.; 267: No. 4, 305-312(Apr 1974). (In German).

2 figs.; 5 tabs.; 6 refs.

On introducing relative and center-of-mass coordinates, the Hamiltonian H of a system of n identical particles with two-body interaction separates into a center-of-mass Hamiltonian and a center-of-mass-independent Hamiltonian H', formally describing a system of n−1 reduced particles. The objective is firstly to investigate the connection between the symmetries of the actual and the reduced system and secondly to discuss the consequences of symmetries of H' on the classification and construction of the eigenstates of H. Angular momentum and parity properties are found to be coincident in the actual and the reduced system. Group-theoretical considerations lead to a method for the determination of reduced vectors with simple transformation properties under permutations of the position vectors which define the reduced vectors. The method is used to construct optimal reduced vectors for the three- and four-body-problem. It is proved that similar optimal reduced vectors do not exist for n > 4. (orig.) (auth)

17525 PROBABILITY DENSITY OF QUANTUM MECHANICS. Kostin, M. D. (Princeton Univ., NJ). J. Chem. Phys.; 60: No. 10, 3999-4000(15 May 1974).

The Schroedinger equation is used to derive a nonlinear equation for the probability density of N independent spatial variables. It is shown that under certain conditions the equation is linear. In these cases a linear equation is then derived for the N-dimensional spatial distribution function of quantum statistical thermodynamics. (auth)

17526 TIME OPERATOR IN QUANTUM MECHANICS. I. Nonrelativistic Case. Olkhovski, V. S.; Recami, E. (Inst. of Theoretical Physics, Kiev). Nuovo Cim.; 22A: No. 2, 263-278 (21 Jul 1974).

Within a space-time description of nonrelativistic quantum objects in terms of wave packets, one may simply consider (for every fixed spatial point $\vec{x}$: see eq. (5)) the "wave-packets" $F(t, \vec{x}) = \int dE f(E,\vec{x}) \cdot \exp[-iEt]$, that one shall assume to have as weight functions the vectors of the functional space P defined as follows. The space P is the space of continuous L^2-functions defined over the (total) energy interval $0 \leq E < \infty$, with square-integrable first derivatives and for which a Hermitian energy operator exists. Such a space P is dense in the Hilbert space of L^2-functions. It is then shown that a "good" time operator exists, $\hat{t} = -(i/2)(\overleftrightarrow{\partial}/\partial E)$, that acts onto P and is "symmetric" (but not self-adjoint), is canonically conjugate to the (total) energy, and satisfies the Ehrenfest principle and Galilei invariance. The old, known objection by Pauli is recognized to point out merely that the operator $\hat{t}$ cannot be hypermaximal, as was clarified by von Neumann. But even nonhypermaximal operators may be given a physical meaning and may represent observables in quantum mechanics. As already emphasized previously, confining one's attention only to self-adjoint operators in quantum mechanics is too restrictive a postulate. Notwithstanding that $\hat{t}$ has no true eigenfunctions, nevertheless one succeeds in calculating the average values of the time operator over the "wave packets" (and over the physical states corresponding to them). The case of wave packets moving freely is first considered. Secondly, the nonfree cases of scattering by a potential are investigated. (auth)

17527 INEQUALITY STRONGER THAN BELL'S INEQUALITY. Gutkowski, D.; Masotto, G. (Univ. Palerno, Italy). Nuovo Cim.; 22B: No. 1, 121-130(11 Jul 1974).

It is shown that, for a system consisting of two spin-½ particles, every local hidden-variable theory must satisfy a certain inequality D. It is shown that the inequality D implies Bell's inequality. An example is given in which Bell's inequality is satisfied while inequality D is violated. The same example shows that a nonempty set of (logically) possible results exists which are consistent both with quantum mechanics and with Bell's inequality, but which are

not consistent with inequality D and hence not consistent with a local hidden-variable theory. A necessary and sufficient condition is given for Bell's inequality and inequality D to be equivalent; this condition is not generally satisfied for the system considered. (auth)

17528 MEASUREMENT IN GENERAL QUANTUM THEORY. d'Espagnat, B. (Laboratorie de Physique Theorique, Orsay, France). Nuovo Cim.; 21B: No. 2, 233-257(11 Jun 1974).

The question under investigation is: Can the assumption that some observables of some physical systems (including measuring instruments) have in all circumstances definite values be made compatible with the linear laws of evolution of quantum mechanics by means of the hypothesis that not all Hermitian operators of a macrosystem correspond to observable quantities? To that effect the meaning of the assumption under study is clarified, and the conditions under which a retrodictive calculation should be considered as reliable are examined. The results can then be applied to the problem at hand. With proper specifications, the conclusion is negative. This is interpreted as being simply a further corroboration — in quantum measurement theory — of a well known fact, which is that any fundamental reality that is assumed to lie beyond the concepts of a mere practical realism and explain them must be considered as being nonseparable. (auth)

Quantum Field Theories

Refer also to abstracts 17019, 17102, 17170, 17171, and 17244.

17529 (COO-2271-28) DUAL TREES AND RESUMMATION THEOREMS. Friedberg, R. (Columbia Univ., New York (USA); Barnard Coll., New York (USA)). 1974. 48p. Dep. NTIS $5.50.

Various resummation theorems known for graphical expansions in statistical physics and field theory are exhibited as special cases of a single symmetrical, easily remembered theorem on a generalized structure called a dual tree. (auth)

17530 (COO-2271-34) VALUE OF FUNDAMENTAL CONSTANTS. Parisi, G. (Columbia Univ., New York (USA). Dept. of Physics). 1974. 8p. Dep. NTIS $4.00.

The way in which renormalized coupling constants depend on the cutoff in a renormalized quantum field theory is studied. Assuming that the cutoff is connected with quantum gravity effects, relations are found between the fine structure constant α, the total cross section e^+e^- into hadrons, and the weak interaction angle θ_W. (auth)

17531 (DESY-73/53) HIGHER ORDER PERTURBATION THEORY OF EXPONENTIAL LAGRANGIANS: FOURTH ORDER. Pohlmeyer, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Nov 1973. 32p. INIS.

9 refs. with abstract. Also published in Comm. Math. Phys. 1974 v. 35(4).

The vacuum expectation value of the time-ordered product of four exponentials of free massless scalar fields is defined as a continuous linear functional over a suitable test function space using minimal singularity as a criterion. (auth)

17532 (JINR-P2-7896) COHERENT STATES. Polubarinov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Some aspects of the coherent states in quantum field theory are reviewed. The coherent states of the scalar, vector and spinor fields are considered. Evolution of expectation values of the field operators in such states is discussed. (auth)

17533 (JINR-E2-7910) SOME CONSEQUENCES OF THE FOURIER ANALYSIS ON THE LORENTZ GROUP FOR RELATIVISTIC QUANTUM MECHANICS. Mavrodiev, S. Shch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 20p. Dep. NTIS (U. S. Sales Only) $4.00.

On the basis of the analogy between the nonrelativistic and relativistic Fourier analysis the uncertainty relation for rapidity and relativistic relative coordinate is formally derived. A geometrical interpretation of the behavior of the elastic scattering differential cross section is given too. (auth)

17534 (JINR-E2-7952) ESSENTIALLY NONLINEAR FIELDS AND VACUUM POLARIZATION. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. Dep. NTIS (U. S. Sales Only) $4.00.

The behavior of the energy density for interacting fields at large gradients is shown to be in agreement with the classification according to their renormalizability. The vacuum polarization resulting in fields with limited derivatives is considered. (auth)

17535 FIRST AND SECOND QUANTIZATION THEORIES OF PARASTATISTICS. Vo-Dai, T. Hamilton, Ont.; McMaster Univ. (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Although usually only two kinds of statistics, namely Bose–Einstein and Fermi–Dirac statistics, are considered in quantum mechanics and in quantum field theory, other kinds of statistics, called collectively parastatistics, are conceivable. Theoretical studies of parastatistics to date are critically reviewed, and several confusions are pointed out and clarified. The "proofs" so far proposed for the symmetrization postulate which excludes parastatistics, emphasizing their ad hoc nature are first studied. Then, after exploring in detail the structure of the quantum mechanical theory of paraparticles, some confusion is clarified concerning the compatibility of parastatistics with the so-called cluster property, which has been an issue of controversy for several years. It is shown following a suggestion of Greenberg, that the quantum mechanical theory of paraparticles can be formulated in terms of density matrix compatibly with the cluster property. Also such topics as selection rules for systems with variable numbers of paraparticles, the connection between statistics and permutation characters, and the classification of paraparticles are discussed. For the quantum field theory of paraparticles, discrete representations of the para-commutation relation are studied, and Greenberg and Messiah's theorem concerning Green's ansatzes is illustrated in detail. Also, fundamental topics such as the spin-statistic theorem, the TCP theorem and the observability of parafields are discussed on the basis of Green's ansatzes. Finally it is pointed out that the so-called particle permutation operators do not always define multi-dimensional representations of the permutation group both in first and second quantization theories. This questions the validity of the correspondence between the two theories which has recently been proposed. (Diss. Abstr. Int., B)

17536 PHYSICO-GEOMETRICAL NOTE ON WEYL'S GAUGE INVARIANCE IN A UNIFIED FIELD. Ikeda, S. (Tokyo Univ.). Lett. Nuovo Cim.; 10: No. 8, 341-344(22 Jun 1974).

The spinor ϕ is regarded as the internal degree of freedom annexed to each point x, and a unified field (the (x,ϕ)) field of the x and ϕ fields is constructed. The x and ϕ fields represent the four-dimensional material manifold and the ordinary spinor field respectively, so that the former is likened to the gravitational field governed by the theory of general relativity, while the latter to a physical field governed by quantum mechanics. It is understood that this field theory presents a unified field-theoretical aspect and that the Weyl gauge invariance plays an important role in relation to the concept of connection. Also it is found that the metric of this field is given by $d\sigma\ \phi = h_\lambda\, dx^\lambda \phi$, which has analogy to the metric of wave geometry. (JFP)

17537 RELATIVISTIC FERMION GAS INTERACTING THROUGH A SCALAR FIELD. I. Hartree Approximation. Kalman, G. (Boston College, Chestnut Hill, MA). Phys. Rev., D; 9: No. 6, 1656-1669(15 Mar 1974).

A high-density fermion gas interacting through a scalar field is studied in the relativistic Hartree approximation, as a model for superhigh-density astrophysical systems. The Hartree quasiparticle states are the superposition of positive- and negative-energy states and can be constructed by a Bogoliubov-type canonical transformation. The resulting effective mass is strongly field-dependent, and approaches 0 as the density increases into the ultrarelativistic domain. The ensuing equation of state exhibits a phase transition and a bound state in the intermediate-density range, but becomes perfect-gas-like at high densities. There is no collapse, and stronger coupling enhances the perfect-gas-like behavior. An alternate picture is provided by considering the fermion gas in the background of zero-momentum bosons. Numerical comparisons with existing scalar-meson coupling data are provided, with emphasis on regions of neutron-star densities. (auth)

17538 EQUIVALENCE OF YANG–FELDMAN AND ACTION-PRINCIPLE QUANTIZATION IN PATHOLOGICAL FIELD THEORIES. Gluch, D.; Hays, P.; Kimel, J. D. (Florida State Univ., Tallahassee). Phys. Rev., D; 9: No. 6, 1674-1678(15 Mar 1974).

The quantization of pathological field theories, suffering noncausal propagation properties and the Johnson-Sudarshan effect, is investigated from both the Yang-Feldman and action-principle points of view. For a particularly simple system of this kind, the two quantization approaches are shown to be exactly equivalent. It is argued that the equivalence also holds for theories of interacting spin-$\frac{1}{2}$ fields. (auth)

17539 OPERATORS OF THE CLASSICAL FIELD AND SEMICLASSICAL ELECTRODYNAMICS. Gordov, E. P.; Tvorogov, S. D. (Inst. of Atmospheric Optics, Tomsk, USSR). Phys. Rev., D; 9: No. 6, 1711-1716(15 Mar 1974).

The operators of the classical electromagnetic field, whose eigenvalues are the corresponding classical fields, are introduced. The use of eigenfunctions of classical field operators in describing the transition from the free quantum field to the classical one is considered. The scheme for the derivation of the semiclassical approximation from nonrelativistic quantum electrodynamics is improved. The limits of applicability of the semiclassical approximation are considered. (auth)

17540 MOTION EQUATION FOR TWO PARTICLES IN RELATIVISTIC QUANTUM MECHANICS. Fushchich, V. I. (Inst. of Mathematics, Kiev). Lett. Nuovo Cim.; 10: No. 4, 163-167(25 May 1974).

A new Poincare-invariant equation for two particles with masses m_1, m_2 and spin $s_1 = s_2 = 1/2$ is proposed in the framework of relativistic quantum mechanics. It is a first-order linear differential equation for the eight-component wave function. With the help of this equation the description of the motion of two-particle systems is reduced to the description of one-particle systems in the (1 + 6)-dimensional Minkowski space which can be in two spin states (s = 0 or 1). (JFP)

Gravitation and General Relativity

Refer also to abstracts 16888, 16889, and 17536.

17541 (NP-20069) ON THE DYNAMICS OF GRAVITY AND MATTER FIELDS. Quale, A. (Oslo Univ. (Norway). Fysisk Institutt). 1969. 38p. Dep. NTIS (U. S. Sales Only) $5.00.

Thesis.

A new approach to gravitational field dynamics is proposed, as an alternative to the standard formulation of general relativity. The space-time metric tensor is split into an externally fixed background geometry (inertia) and a local dynamical field (gravity); and a dynamical theory of matter and gravity in the inertial background is developed. The physical origin of inertia (Mach's principle), and its observable properties, are discussed. The coordinate representations of inertia and gravity are found to have an internal gauge degree of freedom, due to the equivalence principle; the transformation properties of these fields, and the notion of covariant gauge conditions, are discussed. The dynamics of matter and gravitic fields is then investigated, using: The group of motion of the inertial background, appearing as an externally fixed Lie symmetry in the matter and gravity action principles, which yields weakly conserved energy-momentum-like objects; and an internal symmetry gauge group, yielding strongly conserved "internal currents". A fully covariant field-theoretical formalism is used, in which all quantities and operations are tensorial; the well known difficulties of "coordinate effects" in the standard nontensorial formulation are thus avoided. The physical significance of various types of conservation laws is discussed; and a complete family of energy-momentum tensors of gravity, covariantly conserved together with the matter energy-momentum, is deduced from a tensorial action principle. Treating gravity as an independent dynamical interaction, on an equal footing with other (matter) interactions, one is then finally led to the conclusion that the gravitic energy-momentum of a system is fully determined by the matter energy-momentum; various physical implications of this are discussed in some detail. (auth)

17542 CONFORMAL KILLING VECTOR FIELDS ON TIME-LIKE TWO-SURFACES. Du Plessis, J. C. (Univ. of Witwatersrand, Johannesburg). J. Math. Phys. (N. Y.); 15: No. 3, 329-333(Mar 1974).

A topological description of Killing vector fields as well as conformal Killing vector fields on a 2-space-time is given, and the block diagram extension technique is generalized. (auth)

17543 QUASI-NEWTONIAN COSMOLOGY IN SCALAR-TENSOR THEORY OF GRAVITATION. Gorelik, G. E. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 130-133(1974). (In Russian).

An approximate but relatively simple method is developed mathematically for studying the subject theory. (auth)

17544 MOTION OF PROBE PARTICLES IN A WEAK GRAVITATIONAL FIELD OF THE SLOWLY ROTATING BODY. Pometelin, R. V. (All-Union Scientific Research Inst. of Optical-Physical Measurements, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 100-105(1974). (In Russian).

The trajectories of probe particles in a field of a slowly rotating large body is found from geodesic equations. The method is simpler than the method of Fok and Tul'chiev, and the results obtained with it agree with Kalitsin's results. (tr-auth)

17545 MASSLESS TADPOLES, $\Delta^4(0)$ TERMS AND INFRA-RED PROBLEMS IN THE DIMENSIONAL REGULARIZATION OF QUANTUM GRAVITY. Capper, D. M. (Imperial Coll. of Science and Tech., London). Lett. Nuovo Cim.; 10: No. 10, 413-416(6 Jul 1974).

The $m \to 0$ limit of the previously derived one-loop scalar contributions to the graviton self-energy is considered. It is found that there are no surviving $\ln m^2$ terms and hence there are no off-mass-shell infrared divergences, neither are any counter terms required in addition to those of the $m^2 = 0$ case. (JFP)

17546 GRAVITATIONAL SLAVNOV-WARD IDENTITIES. Capper, D. M.; Medrano, M. R. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., D; 9: No. 6, 1641-1647(15 Mar 1974).

Functional techniques are used to derive the general Slavnov-Ward identities for the quantized gravitational field. These identities are verified to second order in the coupling constant, employing the technique of dimensional regularization. (auth)

17547 REDUCTION OF THE EINSTEIN SYSTEM. Kulhanek, J. D. (Laboratorni Pristroje, Prague). Lett. Nuovo Cim.; 10: No. 9, 389-392(29 Jun 1974).

A congruence of time lines is used as a frame of reference for the reduction of the Einstein system. The fundamental quantities are time invariant as well as three-covariant. Previous work is discussed in the light of these results. (JFP)

17548 ON THE ROLE OF CONFORMAL INVARIANCE IN GENERAL RELATIVITY AND THE ORIGINS OF MASS. Bramson, B. D. (Oxford Univ., (UK). Mathematical Inst.). Phys. Lett., A; 47: No. 6, 431-432(6 May 1974).

It is shown how general relativity may be derived from a conformally invariant theory of gravitation in interaction with matter after recognizing the existence of a family of canonical gauges. In this manner the concept of rest mass emerges alonside that of a gravitational constant. Furthermore, the difference between the spin 2 and conformal curvature fields is explained. (auth)

17549 CAUCHY INITIAL-VALUE PROBLEM AND APPLICATION TO SCHWARZSCHILD AND FRIEDMANN METRICS. Meinhardt L., R. (Univ. of Chile, Santiago). Nuovo Cim.: 21B: No. 2, 315-324(11 Jun 1974).

We obtain Schwarzschild and Friedmann's solutions using the constraint and evolution equations of the Cauchy initial-value problem for the Einstein equations. We also give the determination of the constraint and evolution equations for the Gauss-Codazzi equations of differential geometry. We solve the constraint equations in some simple cases performing a conformal transformation of the first fundamental form. (auth)

17550 NONEXISTENCE OF STATIC SOLUTIONS OF THE EINSTEIN-WEYL EQUATIONS IN GENERAL RELATIVITY. Wainwright, J. (Univ. of Waterloo, Ont.). Nuovo Cim., 22B: No. 1, 131-138(11 Jul 1974).

It is proved that the combined neutrino gravitational field equations in general relativity admit no nontrivial solutions in a static space-time provided that the energy flow vector of the neutrino field is timelike or null for all observers. (auth)

17551 THEORY OF RELATIVISTIC SUPERDENSE CONFIGURATIONS. Maksyukov, N. I. (All-Union Scientific Research Inst. of Optical-Physical Measurements, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 41-45(1974). (In Russian).

The basic parameters of hyperon, superdense configurations are investigated. Values are obtained for the masses and radii of configurations having central densities from 10^{14} to 10^{26} g/cm^3. (SJR)

17552 GRAVITATIONAL-WAVE TAIL IN EINSTEIN'S LINEAR THEORY. Yadav, B. P. (Physical Research Lab., Ahmedabad, India). Nuovo Cim.; 21B: No. 2, 303-314(11 Jun 1974).

Within Einstein's linear theory of general relativity, it is shown that an axially symmetric gravitational wave is accompanied by an axially symmetric tail which continues even asymptotically. The tail dies off just after its appearance in the Schwarzschild field. The spin coefficient technique is used. (auth)

17553 GENERALIZED LAGRANGIAN FOR GENERAL RELATIVITY AND SOME OF ITS IMPLICATIONS. I. Goenner, H.; Kohler, M. (Univ. Gottingen, Ger.). Nuovo Cim., 22B: No. 1, 79-86(11 Jul 1974).

The most general scalar Lagrangian leading to Einstein's field equations (without the cosmological term) is given by $L = L_0 + (-g)^{1/2} \cdot (aF + bK)$. L_0 denotes the usual scalar density of Einstein's theory while F and K are certain invariants quadratic in the com-

ponents of the curvature tensor. The contribution to L resulting from a = 0 and considered is conformally invariant. The implications of conformal mapping for the Lagrangian formalism are discussed. Due to the vanishing of the Lagrange derivative of $(-g)^{\frac{1}{2}}K$, this density may be expressed as the divergence of a 4-component quantity. A general expression for this quantity is determined without use of special coordinates. New identities for the Riemann curvature tensor or Weyl's curvature tensor are derived which are bilinear in the components of such tensors and their duals. Finally, a contribution to the energy–momentum complex is obtained containing terms quadratic in the second derivative of the metric. (auth)

REACTOR TECHNOLOGY AND REGULATION

17554 (INIS-mf-1171) ACTIVITIES OF THE TECHNOLOGY DEPARTMENT OF THE ARGENTINE NATIONAL ATOMIC ENERGY COMMISSION, 1955–1972. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). Aug 1973. 167p. (In Spanish). INIS.

The principal activities of the Technology Department during the period from 1955 to 1972 are summarized. Advances and studies in the areas of fuel elements, metallurgy, and components of nuclear power plants are discussed. Developments in data acquisition and processing, instrumentation, metallography, and electron microscopy are also indicated. A list of publications by the personnel of the Department is appended. (JSR)

17555 (INIS-mf-1172) NATIONAL ATOMIC ENERGY COMMISSION. Annual Report, 1971. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 84p. (In Spanish). INIS.

The principal activities of the Argentine Atomic Energy Commission during 1971 are summarized. The evolution and the objectives of the Commission are related and its organization is given. The work done by the dependent divisions and principal organs is summarized. In the energy program the primary emphasis is on the nuclear power plant at Atucha and its construction. The second power plant to be installed in the province of Cordoba is described. The following chapters refer to primary materials and fuels, production and application of radionuclides and radiations, and intense radiation sources. Developments in the areas of reactors, physics, chemistry, biology, medicine, agriculture, instrumentation, and metallurgy are indicated. Radiological protection and safety are considered. A list of publications is appended. (tr-auth)

17556 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1974 ANNUAL MEETING, PHILADELPHIA, PENNSYLVANIA, JUNE 23–27, 1974. Farmakes, R. (ed.). Trans. Amer. Nucl. Soc.; 18: 1-401(Jun 1974).

Each of the 393 brief summaries included is listed by title in NSA. The summaries cover sessions on aerospace and hydrospace, controlled nuclear fusion, education, environmental sciences, isotopes and radiation, materials science and technology, mathematics and computation, nuclear criticality safety, nuclear fuel cycle, nuclear reactor safety, power, reactor operations, reactor physics, and shielding and dosimetry. (JWR)

For abstracts of individual papers see: 14750–14760, 14845–14847, 15017, 15062, 15071–15073, 15137–15139, 15199–15206, 15278–15284, 15326, 15327, 15348, 15349, 15364, 15367, 15372, 15421, 15432, 15468, 15526–15529, 15562–15571, 15624, 15625, 15646, 15688–15690, 15700–15703, 15719–15730, 15734–15736, 15740, 15744, 15860, 15861, 15984–15986, 16003–16005, 16019–16023, 16046–16048, 16071, 16072, 16145, 16241–16243, 16259, 16314–16317, 16399–16402, 16460, 16481–16485, 16490–16494, 16498–16504, 16521, 16522, 16966, 17007, 17042, 17310–17331, 17346–17351, 17393, 17457–17465, 17485, 17510–17517, 17557–17565, 17575–17589, 17606–17628, 17646–17655, 17669, 17699–17720, 17749–17774, 17793–17796, 17821–17864, 17903–17919, 17939, 17940, 17950–17961, 17969–17971, 17978–17980, 17992–17994, and 18001–18010.

17557 DUPLICATE PLANT OPTION. Owen, W. H. (Duke Power Co., Seneca, SC). Trans. Amer. Nucl. Soc.; 18: 237-238 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17558 BIENNIAL RETRAINING PROGRAM FOR LICENSED OPERATORS. French, J. L.; Grady, J. D. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 282-283 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17559 REQUALIFICATION: A NEW DIMENSION IN TRAINING. Duvall, F. C. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 18: 283-284(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17560 CP AND L'S REACTOR OPERATOR REQUALIFICATION PROGRAM. Collins, J. M.; Connelly, J. (Carolina Power and Light Co., Hartsville, SC). Trans. Amer. Nucl. Soc.; 18: 284(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17561 OPERATOR REQUALIFICATION. Collins, P. F.; Holman, J. J. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 284-285(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17562 SPECIAL INSTRUMENTATION NEEDS FOR STARTUP TESTING. Sears, C. F.; Epprecht, M. J. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 18: 286 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17563 ESTABLISHING AN OPERATIONAL QA PROGRAM. Trammell, C. M. III (Public Service Electric and Gas Co., Hancocks Bridge, NJ). Trans. Amer. Nucl. Soc.; 18: 292-293(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17564 QUALITY ASSURANCE ACTIVITIES FOR THE OPERATIONS PHASE OF NUCLEAR POWER PLANTS. Lobbin, F. B.; Scott, W. R. (General Physics Corp., Columbia, MD). Trans. Amer. Nucl. Soc.; 18: 298(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17565 STANDARDS FOR REACTOR PHYSICS DESIGN CALCULATIONS. Weitzberg, A.; Bailey, H. S. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 336-337(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17566 POWER PLANTS WITH AIR-COOLED CONDENSING SYSTEMS. Miliaras, E. S. Cambridge, MA; Massachusetts Institute of Technology Press (1974). 251p. $12.95.

Air-cooled condensing systems for power plants are treated from the aspects of history, heat exchangers, impact on power plant and turbine design, economics, and system considerations. The state of the art and potential improvements and advances in the separate processes and components, and their optimal thermodynamic and economic integration in a power generation cycle are presented. (DG)

17567 NUCLEAR FISSION. Nuclear Reactor. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 265-292 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

Nuclear fission and reactors are discussed. The fission process mechanism is explained, as well as the fission effects (fission products, release of prompt and delayed neutrons, fission product radioactivity, energy release). Also discussed are some other problems such as: fission accomplishment, fission process imitation, neutron diffusion and slowing down, chain-fission and its multiplication coefficient, as well as the accomplishment of the chain fission reaction with fast neutrons. One of the paragraphs is devoted to the presentation of the main processes taking place in nuclear reactors and of main component parts of a reactor. (INIS)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 17664, 17799, 17809, 17810, 17824, 17845–17847, 17852, 17864, 17867, 17872, 17873, 17881, 17974, 17996, 17999, and 18000.

17568 (AED-CONF-74-6-7) LOAD CHANGES IN BOILING WATER REACTORS AND THE REACTIVITY BEHAVIOR TOWARDS THE END OF THE CYCLE. Dyck, H. P.; Pohl, P. G. (Kraftwerk Union A. G., Frankfurt am Main (F. R. Germany)). 1974. 8p. (In German). INIS.

From experts meeting of the task groups "thermodynamics and fluid dynamics" and "reactor physics" of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactor; Karlsruhe, F. R. Germany (29 Jan 1974).

Slow transients under normal reactor operating conditions are discussed. Emphasis is placed on the load changes and reactivity behavior towards the end of the cycle. (INIS)

17569 (CONF-721018-(Vol.1), pp 136-148) ENGINEERING APPROACH TO SHIELD DESIGN. van Halem, H.; Kuiken, R. (Comprimo NV, Amsterdam). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

In order to obtain an optimized shield design that satisfies the safety limits and operates at minimum cost an estimate should be made of the basic errors in the parameters governing shield design. This evaluation applies specifically to bulk shielding of boiling water reactors, but the results are thought to be conclusive for pressurized water reactors as well. Major errors are due to neutron cross sections, to gamma yields and to the effect of drying out of the concrete. The total error margin evaluated corresponds to approximately 15 cm in concrete thickness. Further reduction of the error margin requiring more extensive calculations is economically unattractive. 16 references. (auth)

17570 (CONF-721018-(Vol. 3), pp 702-716) CHOICE OF CHARACTERISTIC ELEMENT COMPONENTS IN CONCRETE FOR SHIELDING CALCULATIONS ON BIOLOGICAL SHIELDS FOR POWER REACTORS. Schultz, H.; Vogt, H. G. (Technische Univ., Hanover). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The results of attenuation calculations for biological reactor shields are often hard to compare because of different elemental compositions for the concretes. In order to estimate the influence of the concrete composition test calculations were made for the biological shield of a water cooled power reactor with extreme variations of the concrete aggregates. It turned out that for all investigated concretes (normal concrete and heavy concretes) mean compositions can be recommended without too large errors to be expected. Furthermore characteristic values for the water and iron contents are proposed because of their strong influence on the attenuation. (auth)

17571 (CONF-721018-(Vol. 3), pp 860-880) ACCESS TO THE PRESSURE VESSEL OF A DIRECT CYCLE BWR FOR INSPECTION AND MAINTENANCE. Hock, R.; Seifferth, L. (AEG-Telefunken, Frankfurt am Main). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

In power plants currently under construction inspection of the important parts of the pressure vessel has to be included in the design. In order to avoid expensive and less reliable inspection devices with remote control, direct access is desirable. Measurements of dose rates after shutdown have been performed under different conditions: vessel drained or filled with water, reactor core in place or unloaded. It was shown, that rather simple calculations are in good agreement with these measurements. The same calculational methods have been used to predict the dose rates after shutdown in new plants. (auth)

17572 (CONF-721018-(Vol. 3), pp 1026-1046) CONTROL OF SHIELD CALCULATION BY TEST MEASUREMENTS IN THE BIOLOGICAL CONCRETE SHIELD OF THREE GERMAN POWER REACTORS. Futtermenger, W. (Technische Univ., Hanover); Schultz, H.; Vogt, H. G.; Hecht, G.; Weber, H.; Hock, R. 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Neutron and photon measurements in the biological shields of three German power reactors are compared with design calculations which were performed with removal-diffusion and transport codes. Satisfactory agreement is obtained between the calculated and measured dose rates. The main contribution to the dose rate at great depth is made by high-energy photons from the iron zones in front of the concrete shield. Therefore high accuracy is required for calculating the neutrons and the photon sources in these zones, but not so much for the calculation of the neutrons in the shield. (auth)

17573 (EUR-5104) GARIGLIANO NUCLEAR POWER PLANT. Annual Report, 1972. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). May 1974. 71p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.75. EUR FB 100.-.

A report covering the operating period from 1 March 1972 to 28 February 1973 is presented. The gross electrical output from the time the plant commenced operating commercially to 28 February 1973 was 8 197 million kWh. The gross electrical output from 1 March 1972 to 28 February 1973 was 431 127 000 kWh, the net electrical output about 394 589 000 kWh and the average load factor for the period about 31%. On 23 April 1972 cycle 3 was finished, and the plant was shut down and kept out of commission until 9 December 1972 in order to enable maintenance work to be carried out and the reactor to be loaded with 64 new enriched uranium fuel elements. Up to 23 April 1972 the reactor had operated normally at a decreasing power which was down to 125 MW(e) at the time of shutdown. (auth)

17574 (GU-5309) DRESDEN 1 PLUTONIUM RECYCLE PROGRAM. Semiannual Report for Period Ending December 31, 1973. Krysinski, T. L. (Gulf Nuclear Fuels Co., Elmsford, N. Y. (USA)). Jan 1974. Contract AT(11-1)-2210. 40p. Dep. NTIS $5.00.

The performance of mixed-oxide assemblies during Cycle 8 is described. The inspection of mixed-oxide assemblies at the end of Cycle 8 is discussed. The plutonium recycle demonstration program to date is summarized and future plans are reviewed. (JWR)

17575 ACADEMIC RESEARCH FOR LWR FUEL. Dean, R. A. (Gulf Nuclear Fuels Corporation, Elmsford, NY). Trans. Amer. Nucl. Soc.; 18: 37(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17576 BWR FUEL CYCLE RESEARCH. Crowther, R. L. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 38(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17577 DEMOLITION OF RADIOACTIVE AND CONTAMINATED CONCRETE STRUCTURES BY USE OF EXPLOSIVES. Nemec, J. F. (United Power Assoc., Elk River, MN); Anderson, K. G. Trans. Amer. Nucl. Soc.; 18: 78-79(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17578 SOME HISTORY OF DRESDEN I REACTOR FUEL ELEMENT DEVELOPMENT. Roy, G. M. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 113-114(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17579 IMPACT OF FUEL DENSIFICATION ON THE U.S. LWR INDUSTRY. Rubenstein, L. S.; Ross, D. F. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 120(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17580 FISSION PRODUCT SWELLING IN BWR FUELS. Rowland, T. C.; Marlowe, M. O.; Elkins, R. B. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 124(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17581 FEW-GROUP THREE-DIMENSIONAL BWR BURNUP CODE, COSMO. Uchikawa, S.; Takeda, R. (Hitachi Ltd., Kanagawa, Japan). Trans. Amer. Nucl. Soc.; 18: 178-179(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17582 FUEL CYCLE EFFECT OF ^{236}U IN RECYCLED URANIUM. Sprague, H. O. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 179-180(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17583 STOCKPILING OR RECYCLING OF PLUTONIUM. Economic Evaluation of Two Alternatives in Utilizing LWR Plutonium. Hnilica, K. (Nuklear-Ingenieur-Service GmbH, Hanau, Ger.); Holley, H.; Lahner, K.; Schmale, H. Trans. Amer. Nucl. Soc.; 18: 180-181(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17584 OPERATING EXPERIENCE WITH BOILING WATER REACTOR FUEL. Williamson, H. E. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 248-249(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17585 STARTUP TESTING IN RELATIONSHIP TO OPERATING EXPERIENCES. Worden, W. P. (Commonwealth Edison Co., Morris, IL). Trans. Amer. Nucl. Soc.; 18: 289(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17586 NUCLEAR PLANT STARTUP ADMINISTRATION. Tucker, W. M. (Carolina Power and Light Co., Raleigh, NC). Trans. Amer. Nucl. Soc.; 18: 294(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17587 PARAMETRIC STUDY OF TYPICAL BWR OPERATING CYCLES. Jones, C. R. (Transfer Systems, Inc., North Haven, CT). Trans. Amer. Nucl. Soc.; 18: 296-298(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17588 BENCHMARKING BURNUP CALCULATIONS USING ISOTOPIC RATIOS. Prezbindowski, D. L.; Christensen, D. E. (Battelle Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 314-315(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17589 CALCULATED VERSUS MEASURED CORE PARAMETERS FOR OYSTER CREEK USING ENDF/B DATA. Federico, L. J. (Exxon Nuclear Co., Richland, WA); Bond, G. R.; Zodiaco, V. P. Trans. Amer. Nucl. Soc.; 18: 354(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17590 NUCLEAR FUEL DESIGN FOR LIGHT WATER REACTORS. Sawaguti, Y. (Tokyo Electric Power Co., Inc.). Genshiryoku Kogyo; 19: No. 2, 14-19(Feb 1973). (In Japanese).

History, present problems and future trend of the fuel design for light water reactors (BWRs constructed by GE and PWRs constructed by WH) are reviewed. Change of the fuel design for BWRs from BWR/1 to BWR/5 is explained from the view points of cladding material, length of fuel rods, number of fuel rods per assembly, shape of pellets, and design criteria. Power density (50.8 kW/l) and linear heat rate (18.5 kW/ft) of BWR/4 and 5 are appreciated as the results of improved design. As the present problem, cause of fuel rupture and the counter measures are shortly discussed. As the future trend, improved design of BWR/6 is explained. The increased power density due to the improvement of local power evenness associated with the employment of 8 × 8 rod (148 inches long) assembly and the decreased linear heat rate and fuel temperature are main features of the future BWRs. As for the PWRs, change of cladding material (from stainless steel to Zr-4), size of subassembly, type of control rods, effective length of fuel rods and use of part-length control rods are pointed out as the causes of improved power density and neutron economy. Deformation of cladding tubes due to outer pressure and its counter-measures are explained as the present problem. Like BWRs, decrease of the linear heat rate and fuel temperature is feature of future PWR design. (JA)

17591 SUMMARY OF OPERATING U. S. POWER REACTORS AS OF MAY 1, 1974. Nucl. Safety; 15: No. 4, 482-484(1974).

17592 REACTIVITY ANOMALY DETECTION IN LIGHT WATER REACTORS. Osawa, Y.; Kato, K.; Izumi, M.; Murata, F. (Hitachi Ltd., Kawasaki, Japan). Genshiryoku Kogyo; 19: No. 3, 46-51(Mar 1973). (In Japanese).

The most sensitive detection method of anomaly in reactor core is the one based on reactivity balance, and this reactivity balance represents the balance condition between variation of reactor output and various reactivities considered to be causes of the variation, and is expressed by an equation in which residual reactivity is given as the sum of other reactivities. The method to analyze reactor noise obtained from the observation of fluctuation in reactor output signals, employing power spectrum density or correlation functions of reactor signals, is also a powerful tool. Examples of the above two methods in a few countries and in JMTR are described briefly. In power reactor plants, anomaly detection of turbines, feed water systems and other auxiliary systems, except reactors, is also important. In BWRs, it is being investigated to make anomaly detection model, in which the reactor core dynamic model is incorporated, which represents the interaction among quantities of core condition. (JA)

17593 PROBLEMS OF WATER SUPPLY OF NUCLEAR POWER PLANTS IN SOME COUNTRIES OF WESTERN EUROPE AS SEEN FROM THE RUSSIAN POINT OF VIEW. Martynova, O. I. Arch. Energiewirtsch.; 27: No. 24, 1195-1204(Dec 1973). (In German).

4 figs.; 10 refs.

The experience gained so far with several components of coolant loops in various nuclear power plants in Europe is reviewed. Main emphasis is placed on the problems associated with condensate purification (using slurry filters) in BWR and PWR type reactors. (GE)

17594 FUEL ACCOUNTING METHODS IN NUCLEAR POWER PLANTS. The 'Lingen Method'. Schmidt, I. (Kernkraftwerk Lingen G.m.b.H., Darme/Lingen (F.R. Germany)). Atomwirtsch., Atomtech.; 19: No. 4, 171-173(Apr 1974). (In German).

2 tabs.

The question of how the fuel inventory in a nuclear power plant is to be accounted for in the balance sheet of the operator is of great importance for the profit and loss calculation. According to the German commercial law, fuel elements may appertain to either business capital or floating capital, and there have been different views on this issue for a long time. At the end of 1973, however, the Treasury decided that fuel elements belong to the floating capital. Thereupon, the Kernkraftwerk Lingen GmbH worked out a practical and, with respect to commercial and fiscal law, justifiable method for the accounting of fuel costs. As Lingen method it was proposed as a model for application. (GE)

17595 STRESSED CONCRETE PRESSURE VESSELS FOR LIGHT WATER REACTORS. Schweiz. Bauztg.; 91: No. 43, 1063-1064(25 Oct 1973). (In German).

Stressed concrete pressure vessels for commercial nuclear power plants are under development by Krupp as an alternative to the conventional steel construction. The design of the concrete vessel intended for light-water reactors is similar to that of the 30 MW high temperature thorium plant at Schmehausen. (INIS)

17596 TEST OF REACTOR AT THE TIME OF REGULAR INSPECTION. Experience in No. I Unit of the Fukushima Nuclear Power Station. Kawahito, T. (Tokyo Electric Power Co. Inc.). Genshiryoku Kogyo; 19: No. 12, 37-42(Dec 1973). (In Japanese).

The No. 1 unit (BWR) of the Tokyo Electric Power Company's Fukushima nuclear power station has undergone three regular inspections since its completion in March 1971. In each inspection, the results of previous inspections and routine repair work reports have been referred to for determining important points to be inspected and necessary preventive maintenance to be carried out. The regular inspection is described in general: in-service inspection, leaks in main steam isolation valves, leaks in reactor containment vessels, leaks in reactor-housing building, performance of emergency gas treatment system, closure of main-steam safety and relief valves, explosive valves for boron injection system, fuel, overall interlocking system, emergency stand-by generator, surveillance of pressure vessel structural materials, radiation-monitoring facilities, etc. (JA)

17597 PROCEDURES OF THE REACTOR TESTINGS IN BWR POWER STATION. Ishi, H.; Nakajima, H. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Genshiryoku Kogyo; 19: No. 12, 9-13(Dec 1973). (In Japanese).

The testing operations at a BWR power station at the final stage of its construction are divided into two phases: (1) the testing of various analogous reactor systems before the loading, and (2) start up tests after the loading. The purpose is to confirm safety engineering of the nuclear power plant. In the former test, tests are made under conditions as similar as possible to the actual state of reactor operation, and ascertainment is made on the possibility of executing subsequent fuel loading and start up tests safely and smoothly. In the latter test, various tests of the reactor are performed in actual operation, and safe and efficient operation of the reactor is confirmed. These two tests of a BWR reactor in a nuclear power station are described from the standpoints of planning, procedure of tests and test details. (JA)

17598 POSSIBLE PATHS OF DEVELOPMENT OF WATER-MODERATED WATER-COOLED POWER REACTORS. Skvortsov, S. A. At. Energ. (USSR); 36: No. 6, 439-443(Jun 1974). (In Russian).

Economic and technical indicators characterizing atomic power plants based on water-moderated water-cooled reactors lead one to conclude that such reactors will continue to be used during the next 30 to 40 years even if fast breeder reactors gradually replace them. The development of water-moderated water-cooled power reactors will probably provide for an increase in electric power to 2 to 3 thousand MW. The large vessels required for such powerful reactors will have to be transported along waterways or assembled at the place of installation. It may be possible to use vessels of prestressed concrete. It is most probable that thermodynamic heat parameters will maintain their present values. One can assume that work will be undertaken to improve the fuel cycle of such reactors and to produce new fuel elements of increased heat value. Economic analyses indicate that power plants based on water-moderated water-cooled reactors can undoubtedly compete with plants using organic fuels. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 15861, 17570, 17572, 17575, 17579, 17582, 17583, 17588, 17590, 17591, 17593, 17595, 17598, 17664, 17805, 17810, 17823, 17844–17847, 17856, 17863, 17867, 17872, 17873, 17887, 17997, and 17998.

17599 (AED-CONF-74-6-17) REQUIREMENTS SET BY OPERATING TRANSIENTS. Schmidl, J. (Kernkraftwerk Obrigheim G.m.b.H., Obrigheim/Mosbach (F. R. Germany)). 1974. 11p. (In German). INIS.

From experts meeting of the task groups "thermodynamics and

fluid dynamics" and "reactor physics" of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactor; Karlsruhe, F. R. Germany (29 Jan 1974).

A power output schedule has been established for the interconnected operation of the nuclear power plant Obrigheim and the electricity supply network, taking the permissible load changes into account. The planned operational processes for frequency support of the network require considerably high rates of load change. The output limitations set up for the nuclear power plant Obrigheim are discussed. (INIS)

17600 (CONF-721018-(Vol. 3), pp 628-646) PRACTICAL ANALYSIS OF PRIMARY CONCRETE SHIELD FOR A PWR. Su, S. D.; Patti, F. (Burns and Roe, Inc., Oradell, NJ). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The radiation shielding properties of ordinary concrete at a density of 2.35 g/cc are studied for the primary shield of a selected large pressurized water reactor (PWR) system. The associated heating resulting from radiation incident on the concrete shield is analyzed. The neutron and gamma flux distributions in the shield are obtained with the removal-diffusion NRN code and point-kernel QAD-BR code, respectively. Calculations of the relaxation lengths of fast neutrons and gammas in ordinary concrete are made. The results presented are compared with some reported data. (7 references) (auth)

17601 (CONF-721018-(Vol. 3), pp 898-913) ACTIVITY OF CORROSION PRODUCTS IN THE PRIMARY WATER OF THE CHOOZ REACTOR. Frejaville, G. (CEA, Fontenay-aux-Roses, France); Lott, M.; Marchal, A. 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The concentration and activity measurements of corrosion products in the primary coolant of CHOOZ reactor during steady run and after shutdown are permitted to reach the release rate of the metallic structures (0.8 mg dm^{-2} $month^{-1}$), the half life deposition time in core ($T_{\frac{1}{2}}$ = 10 mn) and out of core ($T_{\frac{1}{2}}$ = 2 h). These measurements show the very important increase of activity in the coolant (~1000) after a shutdown when the temperature is decreased to 100°C. (auth)

17602 (CONF-721018-(Vol. 3), pp 914-922) CONTINUOUS DETERMINATION OF THE DAMAGE RATE OF PRESSURIZED WATER REACTOR VESSELS. Devillers, C.; Dupont, C. (CEA, Fontenay-aux-Roses, France). 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Within the scope of the surveillance programs of reactor pressure vessels, the methods used to evaluate the progression of irradiation embrittlement along the life of the reactor are presented. An idea of measurement which should provide a direct estimation of the fast neutron fluence and of the damage dose is suggested. (9 references) (auth)

17603 (IAEA-PL-504-3) REPAIR OF NUCLEAR STEAM SUPPLY SYSTEMS. Cobean, W. R. Jr. (International Atomic Energy Agency, Vienna (Austria)). 1972. 18p. INIS.

The failure of power plant components is always associated with periods of plant unavailability. Excessive shutdown time is expensive, not only due to the lost electrical generation but also the extra manpower and material needed to effect repairs. The time necessary to complete repairs has been increased by the additional time devoted to taking into account and controlling those aspects of nuclear power related to radiation and contamination. To best illustrate Consolidated Edison's experience with the magnitude and techniques of a major repair program, the activities associated with the repair of a thermal sleeve and associated portion of piping in the Primary System at Indian Point Unit No. 1 are described. The activities have been divided into the following areas of interest; Detection of Failure; Examinations and Cause of Failure; Repair of System; Quality Assurance and Health Physics. The repair of nuclear steam supply systems took seven months and required the use of approximately 700 men, with a resultant whole body exposure of 1120 man-rem. (INIS)

17604 (IAEA-PL-504-8) REPAIR AND INSPECTION OF NUCLEAR PLANTS. Schenk, H.; Pickel, E. (International Atomic Energy Agency, Vienna (Austria)). 1972. 57p. INIS.

Three typical examples of problems and the methods required for repair and inspection work in pressurized water reactors are given: a) repairs of the steam generators; b) the problems associated with the repair of fuel elements; c) a brief review of the ultrasonic inspections performed on the reactor vessel. (INIS)

17605 (SZS-153, pp 256-264) MEASURED EXTERNAL RADIATION EXPOSURE IN THE FIRST SIX YEARS OF OPERATION OF THE NUCLEAR POWER PLANT RHEINSBERG. Schreiter, W.; Babenzien, C.; Schwenzke, G. (VEB Kernkraftwerke, Rheinsberg, Ger.). Aug 1973. (In German).

From fourth international symposium on personal dosimetry; Potsdam, F. R. Germany (10 Oct 1972).

Generally external radiation exposure is the largest part of total radiation exposure of personnel in nuclear power stations. It is measured in the nuclear power plant Rheinsberg using film badges and KID ionization chamber dosimeters. Since 1970 a small computer SER-2 d has been used for analysis of measurements. For the first six years of operation the measured individual external radiation exposures per year and per reactor operation period, respectively, are discussed—subdivided into periods of normal operation and refueling or inspection. Moreover main exposure groups are subdivided into profession groups and working characteristics, respectively. All individual external radiation exposures were lower than MPD. The mean exposures were lower than 10% of power station standard values. Only 1% of exposed persons exceeded 50% of the standard values. (auth)

17606 STEAM GENERATORS FOR THE 3800-MW(TH) WESTINGHOUSE PWR PLANT. Bennett, R. R. (Westinghouse Electric Corp., Tampa, FL). Trans. Amer. Nucl. Soc.; 18: 118-119 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17607 CORE PHYSICS CALCULATIONS FOR THE ZIRCALOY-STAINLESS CORE AT YANKEE. Cacciapouti, R. J. (Yankee Atomic Electric Co., Westboro, MA); Apelian, V. N. Trans. Amer. Nucl. Soc.; 18: 177(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17608 FUEL MANAGEMENT STUDY OF THREE MILE ISLAND UNIT I. Cenko, M. J.; Mann, M. A.; Levine, S. H.; Tourigny, E. G.; Witzig, W. F. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 18: 177-178(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17609 SNUPPS CONCEPT OF STANDARDIZED NUCLEAR PLANTS. Petrick, N. A. (SNUPPS, Gaithersburg, MD); Jensen, R. J. Trans. Amer. Nucl. Soc.; 18: 239-240(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17610 DESIGN CHALLENGES OF OFFSHORE STANDARD PLANTS. Ashworth, J. A. (Public Service Electric and Gas Co., Jacksonville, FL). Trans. Amer. Nucl. Soc.; 18: 240(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17611 PWR FUEL: EXPERIENCE AND CURRENT DEVELOPMENT PROGRAMS. Burley, T. B.; DeStefano, J.; Melehan, J. B. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 249(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17612 PERFORMANCE OF THE OCONEE I CORE. Roy, D. H.; Tulenko, J. S. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 18: 249-250(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17613 FUEL PERFORMANCE EXPERIENCE IN CE AND KWU PRESSURIZED WATER REACTORS. Duncan, R. N. (Combustion Engineering, Inc., Windsor, CT); Smerd, P. G.; Knaab, H.; Manzel, R. Trans. Amer. Nucl. Soc.; 18: 250-251(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17614 MEASURED DOPPLER REACTIVITY TIME CONSTANT CHANGES WITH PWR FUEL BURNUP. Graham, K. F.; Forker, J. M.; Gopal, R. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 279-280(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17615 CORRELATION OF DYNAMIC MODEL PREDICTIONS AND TEST RESULTS FOR A PRESSURIZED WATER REACTOR. Thakkar, J. G.; Kerlin, T. W. (Univ. of Tennessee, Knoxville). Trans. Amer. Nucl. Soc.; 18: 280-281(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17616 OPERATOR RETRAINING PROGRAM AT INDIAN POINT. Burdge, R. E. (Consolidated Edison Co. of New York, Buchanan). Trans. Amer. Nucl. Soc.; 18: 282(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17617 STAFFING FOR A NUCLEAR REACTOR STARTUP PROGRAM: EXPERIENCE GAINED AT TURKEY POINT. Liebler, G. E. (Florida Power and Light Co., Miami). Trans. Amer. Nucl. Soc.; 18: 286-288(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17618 BENEFITS OF A CENTRALIZED ORGANIZATION FOR STARTUP TESTING. Klingaman, R. M. (Metropolitan Edison Co., Reading, PA). Trans. Amer. Nucl. Soc.; 18: 288-289(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17619 SURRY CORE PERFORMANCE DURING CYCLE 1. Rhodes, J. T. (Virginia Electric and Power Co., Richmond); Langford, F. L. Jr. Trans. Amer. Nucl. Soc.; 18: 290-291(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17620 STARTUP PHYSICS TEST PROGRAM AT SURRY UNITS 1 AND 2. Gardner, D. A. (Virginia Electric and Power Co., Richmond); Magaw, J. R. Trans. Amer. Nucl. Soc.; 18: 294-295(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17621 NON-NUCLEAR HEAT INPUT RATE FOR PRAIRIE ISLAND UNIT ONE. Christenson, J. M.; Jones, P. D. (Northern States Power Co., Minneapolis). Trans. Amer. Nucl. Soc.; 18: 295-296(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17622 ON-LINE MONITORING OF REACTOR INTERNALS FOR FLOW-INDUCED VIBRATION. Pitts, T. G.; Simonis, J. C.; Thoren, D. E. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 18: 296(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17623 XENON TRANSIENT ANALYSIS FOR SAN ONOFRE UNIT 1. Chitkara, K.; Deng, S. F.; Lew, B. S. (Southern California Edison Co., Rosemead). Trans. Amer. Nucl. Soc.; 18: 298-300(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17624 AUTOMATIC OPTIMAL SUPPRESSION OF XENON OSCILLATION. Impink, A. J. Jr.; El-Bassioni, A. A. (Carnegie-Mellon Univ., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 307-308 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17625 ALBEDO-ADJUSTED REFLECTOR FAST DIFFUSION COEFFICIENTS. Terney, W. B. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 18: 319-320(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17626 SENSITIVITY OF THERMAL REACTOR PROMPT DOPPLER FEEDBACK TO POWER SHIFTS. Ostensen, R. W.; Axford, R. A. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 18: 333(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17627 COMPARISON CALCULATIONS FOR PWR DESIGN METHODS USING ENDF/B CROSS-SECTION DATA. Skogen, F. B. (Exxon Nuclear Co., Richland, WA); Stocks, W. M. Trans. Amer. Nucl. Soc.; 18: 353-354(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17628 COOPERATIVE RADIOACTIVITY AND RADIATION MONITORING PROGRAM FOR OCONEE. Grant, P. J. (Babcock and Wilcox Co., Lynchburg, VA); Hallman, D. F.; Kennedy, A. J.; Smith, D.; Uhl, D. L. Trans. Amer. Nucl. Soc.; 18: 355-356(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17629 THEORY OF PUMP-INDUCED PULSATING COOLANT PRESSURE IN PRESSURIZED WATER REACTORS. Penzes, L. E. (Combustion Engineering, Inc., Windsor, CT). Nucl. Eng. Des.; 27: No. 2, 176-188(1974).

The theory of pump-induced pulsating pressure distributions in a PWR coolant annulus is developed. The calculated pressure distribution can then be applied to predict the dynamic responses of the reactor internals. The mathematical analysis is formulated in accordance with the linearized Navier–Stokes' equations by assuming a compressible, inviscid liquid. These equations are combined to form a single equation in terms of the unknown pressure distribution. The boundary conditions are two concentric rigid walls in the radial direction and any combination of closed, open, and piston-spring supported end conditions in the axial direction. The pulsating pump pressure which induces the pressure fluctuation in the annulus is prescribed at a small opening of the outer cylindrical wall (pump inlet of the reactor). An approximate solution is obtained by introducing the concept of time-dependent body force in the governing differential equations. With this conceptual substitution for the actual loading, the time-dependent, mixed boundary value problem can be represented as a forced vibration problem with homogeneous boundary conditions. This problem can then be solved by the method of normal modes. Numerical examples are provided which give the pressure distribution in the axial and circumferential directions of the annulus for various configurations of one and/or several pumps. (auth)

17630 THE 1,300 MW UNIT B OF THE BIBLIS NUCLEAR POWER STATION. Euerkle, W.; Schamburger, R. (Kraftwerk Union A.G., Erlangen (F.R. Germany)). Kerntechnik; 15: No. 9, 408-415(Sep 1973). (In German, English).
2 figs.; 1 tab.; 5 refs.
Two years after the start of construction on the 1,200 MW Biblis nuclear power station the decision was taken to build a further power unit on the same site. The new unit is called Unit B and is designed for a gross electric power output of 1,300 MW. Its basic design is nearly identical to that of Unit A except for various improvements, particularly in the design and layout of system with important safety functions. The cooling water system of Unit B allows direct river water cooling as well as cooling tower cooling. (GE)

17631 DETERMINATION OF THE FRICTION FACTOR FOR A FUEL ELEMENT ASSEMBLY MODEL OF PWR TYPE. Grecov, D.; Haiduc, C.; Bercovici, D. Rev. Roum. Sci. Tech., Ser. Electrotech. Energ.; 19: No. 1, 181-191(1974).
The variation of the friction factors in isothermal and non-isothermal regimes with the Reynolds number for a fuel element assembly model of PWR type, as well as the relation between these factors, was determined. Proceeding from the Chilton-Colborn analogy, a relation was obtained for determining the heat transfer coefficient. This relation takes into consideration the manner in which the bars are placed in the array. (auth)

17632 CRYOGENIC SYSTEM FOR PROCESSING WASTE GAS FROM A PWR POWER GENERATING STATION. Thrall, G. M. (CVI Corp., Columbus, OH); Pilmer, D. F. pp 144-150 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).
From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.
The continuing effort by utility companies to demonstrate that nuclear power stations can provide vitally needed electrical energy while still protecting the environment has led to the development of various new radwaste processing systems. One such system, employing cryogenic adsorption, has been developed to reduce the activity level of the waste gas emitted from a pressurized water reactor generating station. This prototype system, the first operational unit of its type, is installed and has been successfully operating since August 30, 1972 at the San Onofre Nuclear Generating Station, owned by the Southern California Edison and San Diego Gas and Electric Companies. The cycle and the proven thermodynamic and cryogenic adsorption principles on which the design is based are discussed. Considerations pertinent to component selection and system design such as leak tightness, equipment accessibility, maintenance and safety factors are presented. Installation and integration of the skid mounted equipment package into the reactor system are described. Actual performance data is presented and a comparison to the design model is made. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 16139, 17591, 17872, 17884, and 17970.

17633 (CONF-721018-(Vol.1), pp 149-165) PROTECTION AGAINST RADIATION BY NUCLEAR ENGINEERING. Jegu, J.; Maire, D.; Poitou, M.; Prouillac, C. (Groupement Atomique

Alsacienne Atlantique, Le Plessis-Robinson, France). 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

A G.A.A.A. team has been working for more than 15 years on the design of nuclear reactor shielding. This team needs to work out both simplified computation tools and efficient processes, using the most sophisticated computation codes and carrying out by itself some codes at the same time. After a definition and different considerations about the task of the shielding engineer in the projects, several comparisons between results of anticipated calculations and measures are presented about the Chinon 3 fuel handling facilities and the Celestin 1 reactor (during starting-up and normal operation for the water loops). The ways through which G.A.A.A. is building up its own computation codes are shown. 20 references. (auth)

17634 (CONF-721018-(Vol. 3), pp 647-663) RADIATION FLUX AND HEATING LEVELS IN THE HTGR. Engholm, B. A. (Gulf General Atomic Co., San Diego, CA). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The radiation environment within the prestressed concrete reactor vessel (PCRV) of the High-Temperature, Gas-Cooled Reactor (HTGR) is discussed. The methods used for radiation control and the associated shielding analysis and design procedures are described. The design objectives which have been achieved are: restriction of the fast-neutron fluence to the PCRV liner to less than 2×10^{18} nvt (E > 1 MeV); reduction of nuclear heating in the PCRV concrete to approximately 1 mW/cm^3; and limitation of gamma exposure of the inner-tendon lubricant to 5×10^9 rad. (18 references) (auth)

17635 (CONF-721018-(Vol. 3), pp 731-740) HEAT GENERATION IN SHIELD LAYERS OF A HIGH-TEMPERATURE REACTOR. Hofmann, K.; Wahsweiler, H. G.; Weicht, U. (Hochtemperatur-Reaktorbau GmbH, Cologne). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The design of internal shielding of the THTR, a high-temperature reactor now under construction, was based on the removal-diffusion method. In particular, computation of heating in the shield layers was performed with the code SABINE. The criteria for this choice are indicated. The sources of error, which are particular for this type of reactor, are analyzed. The modifications to the program in order to obtain results which meet the engineering requirements on accuracy are described. (auth)

17636 (CONF-721018-(Vol. 3), pp 771-787) SOME PROBLEMS ASSOCIATED WITH CALCULATING THE ON-LOAD DOSE RATES ON THE PILE CAP OF AN ADVANCED GAS COOLED REACTOR. Dutton, L. M. C.; Palit, A. (British Nuclear Design and Construction Ltd., Leicester, Eng.). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The design and calculational problems associated with neutron streaming up the annular coolant gap around the fuel stringers of an Advanced Gas Cooled Reactor are discussed. Because of the relative operational movements of the major reactor components, this streaming path is expected to be the main cause of a small but continuous on-load dose rate above the pile cap flooring. The effects of these movements are examined and the resulting variation in the pile cap dose rate is presented. (6 references) (auth)

17637 (CONF-721018-(Vol. 3), pp 828-859) CALCULATION OF THE CIRCUITS ACTIVITY IN A HIGH TEMPERATURE REACTOR. Brisbois, J.; Beslu, P.; L'Homme, A. (CEN, Saclay, France). 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

In a HTR reactor, the circuits activity, particularly the heat exchanger activity, comes mainly from the metallic fission products escaped from the fuel. Such a fuel is made from oxide particles coated with PyC and SiC, but part of it has a defective coating (due to fabrication hazards or irradiation damages). The present paper explains how one can calculate the fission products activity in the circuits, knowing the number of failed particles. The calculations can be divided in two steps: migration of the fission products through graphite parts of the fuel; and migration of the fission products in the circuit. For both these problems, a model has been developed from the study of the physical phenomens concerned. Example is given of an application to a 3000 MW(t) reactor. (13 references) (auth)

17638 (CONF-721018-(Vol. 3), pp 973-994) INVESTIGATIONS OF SHIELDING PROBLEMS ARISING FROM MODIFICATIONS TO REFUELLING MACHINERY AT TRAWSFYNYDD POWER STATION. Pugh, I. G. (Central Electricity Generating Board, Cheltenham, Eng.); Hoverd, R. S.; Avery, A. F. 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

An extensive series of calculations and measurements performed for a complex arrangement of shielding which recently required investigation on an operating power station is presented. The original design calculations using one-dimensional removal-diffusion plus line of sight methods are described and the resulting dose rates compared with measured values. As the dose rates were considered to be excessive various methods of reduction are investigated; firstly, mock-up experiments using temporary polythene shielding are described, secondly the effect of an increase in decay of the fuel is investigated and finally Monte-Carlo calculations are used to identify weak penetration paths in the shield arrangement. (6 references) (auth)

17639 (CONF-721018-(Vol. 3), pp 1064-1097) COMPUTATIONAL METHODS FOR GRAPHITE GAS-COOLED REACTORS SHIELDING: COMPARISON WITH SHIELDING MEASUREMENTS MADE DURING START-UP TESTS. Brisbois, J. (CEA, Paris); Duco, J.; Bourdeau, F.; Chapus, J. 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The main shielding problem of the graphite gas-cooled reactors, in particular for reactors with integrated exchangers, is the possibility of access inside the primary system after shutdown for inspection or repairs of the internal structures. The problem arises essentially above the exchanger which is protected from direct radiation by a shield located in the structure of the supporting area and at the lower end of the peripheral gap provided for "cold" gas flow and which is a privileged path from neutrons from the reactor core. The computational methods which were developed and their adjustment on mock-ups are presented. Results obtained on the Saint Laurent I, Saint Laurent II and Bugey power plants by shielding measurements during start-up are compared to predictions made from the calculation methods. (21 references) (auth)

17640 (CONF-721018-(Vol. 3), pp 1098-1130) EXPLOITATION OF A SIMPLIFIED ALBEDO THEORY FOR NEUTRON AND GAMMA-RAY STREAMING IN PRACTICAL DESIGN SITUATIONS. Miller, P. C.; Packwood, A. (Atomic Energy Establishment, Winfrith, Eng.). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The essential requirements of radiation streaming methods for gas-cooled reactor design are discussed. It is shown that these can be most readily achieved by kernel-albedo methods for the simpler geometries but that Monte Carlo albedo methods are necessary for more complicated situations. Acceleration techniques for the Monte Carlo albedo method are discussed. The required accuracy of the albedo data, and the importance of albedo angular dependence terms are indicated by comparison of calculations with various measurements in multilegged ducts. (22 references) (auth)

17641 (EUR-5073) LATINA NUCLEAR POWER PLANT. Annual Report, 1972. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). May 1974. 48p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.50. EUR FB 70.-.

In 1972: gross production: 1,204,140,044 kWh; utilization factor: 85.68%, calculated on the basis of an electric power reduced from 210 to 160 MW(e) in order to limit the oxidation of steels in the presence of CO_2. Accumulative gross electricity generated by 31 December 1972: 11,702,832,184 kWh; utilization factor: 74.56%, from the beginning of commercial operation. Main activities referred to: operations designed to throw light on the phenomenon of oxidation of steels and the associated effects on the reactor structures; up-to-date assessment of the reactor structure study, particularly of core restraint bars; their operation checked in case of rupture of bars; studies to ascertain the possibility of carrying out repairs on components inside the reactor. (auth)

17642 (GERHTR-87) ANISOTROPY VARIATION OF CRYSTALLOGRAPHIC ORIENTATION IN PYROCARBON COATINGS OF FUEL PARTICLES BY ANNEALING AND NEUTRON IRRADIATION. Koizlik, K. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). Apr 1973. 62p. Dep. NTIS (US Sales Only) $6.25.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Optical measurements were used to determine the orientation anisotropy directly at the pyrocarbon coatings of fuel particles. A correlation is detected between anisotropy factors by means of optical and x-ray measurements. The optical measurement detects the orientation anisotropy and its variation by annealing

and neutron irradiation of the particle coatings. Also, dependencies are shown between the material properties of pyrocarbon, annealing, or irradiation data, and the anisotropy increase. To explain the measured results, a model is discussed and compared with those suggested in the literature. (43 fig, 112 references) (auth)

17643 (GULF-GA-A-12335) CONTROL ROOM FLEXIBILITY PROVIDED BY HTGR SYSTEM. Dye, M. M. (Gulf General Atomic Co., San Diego, Calif. (USA)). Feb 1973. 14p. (CONF-7209116-1). Dep. NTIS $4.00.

From engineering computer forum conference; Detroit, Michigan, USA (25 Sep 1972).

The control room system of the Fort St. Vrain HTGR is discussed, and emphasis is placed on three features of the system which permit flexibility in meeting the particular needs of individual utilities while holding down costs through standardization of components. The features are (1) the remote multiplexer, (2) the data acquisition and processing system, and (3) modularly designed control room equipment. (DG)

17644 (IAEA-PL-504-2) EXPERIENCE AND TECHNIQUES IN THE REPAIR OF REACTOR COMPONENTS IN CEGB NUCLEAR POWER STATIONS. Vowles, A. E. (International Atomic Energy Agency, Vienna (Austria)). 1972. 16p. INIS.

Brief reference is made to recovery and inspection activities within pressure vessels of a number of reactors, since it was during such operations that considerable experience was gained in remote controlled handling of tools and lighting and viewing equipment. Repair work on reactor core components at two nuclear power stations is described together with the organization for carrying out the work. (INIS)

17645 (ORNL-TM-4493) HTGR FUEL KERNEL MIGRATION DATA FOR THE Th–U–C–O SYSTEM AS OF APRIL 1, 1974. Lindemer, T. B.; Olstad, R. A. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 47p. Dep. NTIS $5.45.

The currently available quantitative data for the kernel migration coefficient (KMC) in pyrolytic-carbon-coated HTGR fuel particles are presented. In-reactor KMC values are reported for kernels composed of ThO_2, $Th_{1-x}U_xO_2$, UO_2, and ThC_2, while out-of-reactor KMC values are reported for ThC_2, $Th_{1-x}U_xC_2$, and UC_2 kernels. The migration rates of all these kernel types appear to be controlled by solid-state diffusion processes that operate when the kernel is in a temperature gradient. To date, the migration of oxide kernels has been reported only for in-reactor experiments. There is no apparent dependence of the KMC upon the extent of fission for either carbide or oxide kernels. The relative rate of in-reactor migration of the fuel compounds was established in one set of comparative experiments and appears to have the order $ThO_2 < Th_{1-x}U_xO_2 < ThC_2$ in the temperature range of 1100 to 1900°C; UO_2 appears to exhibit the fastest migration rate at $T \leq 1200$°C. (auth)

17646 DUAL-PURPOSE HTGR FOR MILITARY INSTALLATIONS. Nida, A. V. (Army Facilities Engineering Support Agency, Fort Belvoir, VA); Golay, M. W. Trans. Amer. Nucl. Soc.; 18: 245(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17647 IRRADIATION EXPERIENCE WITH HTGR FUELS IN THE PEACH BOTTOM REACTOR. Scheffel, W. J.; Scott, C. B. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 247-248(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17648 FORT ST. VRAIN TESTING PROGRAM. Kantor, M. E. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 257(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17649 FORT ST. VRAIN PROCESS AND MECHANICAL SYSTEMS TESTS. Wheeler, C. C. Jr. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 257-258(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17650 FORT ST. VRAIN HOT FUNCTIONAL TEST. Phelps, R. D. (General Atomic Co., Platteville, CO). Trans. Amer. Nucl. Soc.; 18: 258-259(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17651 FORT ST. VRAIN INITIAL FUEL LOADING AND PHYSICS TESTS. Asmussen, K. E.; Brown, J. R.; Nirschl, R. J.; Pfeiffer, W. W.; Simon, W. A. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 259(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17652 AFTER HEAT GFNERATION IN THE HTGR. Sund, R. E. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 274-275(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17653 PICKERING G.S. REACTOR STARTUP AND EARLY OPERATING EXPERIENCE. Jones, J. E.; Turcott, G. E. (Ontario Hydro, Pickering). Trans. Amer. Nucl. Soc.; 18: 289-290 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17654 DESIGN OF A MIXED CRITICAL SYSTEM FOR NON-CENTRAL GCFR MEASUREMENTS. Ottewitte, E.; Richmond, R. (Swiss Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). Trans. Amer. Nucl. Soc.; 18: 313-314(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17655 MONTE CARLO ALBEDO ANALYSIS OF HTGR RADIATION STREAMING. Slater, C. O. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 397-398(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17656 NUCLEAR FUEL DESIGN FOR HIGH TEMPERATURE GAS COOLED REACTORS. Shimokawa, J.; Shindo, R.; Miyamoto, Y. (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 19: No. 2, 20-24; 29(Feb 1973). (In Japanese).

Features of the fuel for HTGRs and design problems of coated fuel particles, fuel pellets and fuel elements are reviewed. High temperature, high thermal efficiency and the flexibility of fuel cycle are emphasized as the special features of the HTGRs. There are many types of the coated fuel particles (BISO and TRISO-2) and many types of the fuel elements. Difference between the BISO and TRISO-2 is briefly explained. The relation between size of the fuel particles and resonance absorption is discussed from the viewpoint of reactor physics. Difference between carbide and oxide fuel nuclei is also discussed from the viewpoints of performance and fabrication. Two different mechanisms, chemical and mechanical, of rupture of the coated fuel particles due to neutron irradiation are briefly explained with suggestion that stochastic inspection of fuel particle production may become more important. The design problems of fuel pellets and fuel elements are discussed from the viewpoints of (i) uniformity and integrity of the coated fuel particles, (ii) stability at high temperature and under high neutron irradiation, (iii) easiness of fabrication and inspection, and (iv) thermal conductivity. The fuel elements for Dragon, Peach bottom, THTR and Fort St. Vrain reactors are explained as existing examples. (JA)

17657 SYSTEM DESIGN FOR A HIGH-TEMPERATURE GAS COOLED REACTOR. Ishikawa, H.; Shimokawa, J. I.; Yasuno, T. (Japan Atomic Energy Research Inst., Tokai). Nippon Kikai Gakkaishi; 76: No. 654, 774-782(Jun 1973). (In Japanese).

High-temperature gas cooled reactors are attracting world interest in recent years; not only the type is superior in terms of high temperature attainable, but it is also advantageous in environmental conservation. To realize successful system as a whole, however, components must be chosen and put together effectively for the final objective. System design of high-temperature gas cooled reactors is described on the following: HTGR components including reactor core, pressure vessel, reactor structure, cooling system, and measurement and control system; system design, such as design consideration and plant reliability; and development of a multipurpose high-temperature gas cooled reactor in JAERI, experimental reactor with coolant outlet temperature 1000°C and heat output 50 MW. (JA)

17658 IMPROVEMENTS IN OR RELATING TO FUEL FOR NUCLEAR REACTORS. Prince, K.; Shennan, J. V. (to United Kingdom Atomic Energy Authority). British Patent 1,347,487. 20 Feb 1974. Filed date 8 Jul 1970. 2p.

Reference is made to fuels for high temperature reactors. A method of manufacture is described that is applicable to both tubular and hollow fuel pins. An assembly of fuel compacts and sheaths is formed with the sheaths in an unfinished condition and the assembly is then heat treated to bond the sheaths and compacts together. The sheaths are formed from graphite and a resin binder and while the sheath is still in a plastic state the assembly is pressed under isostatic pressure within the fuel compact in the sheath. For tabular fuel pins the sheathing comprises an inner

and an outer sheath for each fuel pin; a hollow fuel pin has only a single sheath. The sheath is conveniently formed with one integral end cap, the opposite end cap being fitted after insertion of the fuel compacts. The material for the sheath is preferably similar to that of the matrix of the fuel compacts, in order to achieve good bonding and similar properties. Longitudinal finning may be provided. One advantage is elimination of the possibility of a gap arising between fuel compacts and sheath as a result of differential shrinkage under irradiation. Manufacturing costs may also be reduced. (UK)

17659 SICHERUNG DER ENERGIE- UND ROHSTOFFVERSORGUNG DURCH NUKLEARE PROZESSWAERME. (Guarantee of the Energy and Raw Material Supply in Nuclear Process Heat). Essen; Bergbau-Forschung GmbH (1973). 63p. (In German).

The present world situation with respect to a guaranteed supply of energy and its increasing cost is outlined. The future supply and demand with respect to coal, natural gas, petroleum, and nuclear energy is considered from the viewpoint of the producer and consumer. The deterioration of the energy economy in the U.S.A., European Common Market, Japan, and the under-developed nations is summarized. Energy supplies in Western Europe are discussed from the viewpoint of the increasing international competition for energy sources. The present supplies of natural gas in Western Europe are described and the future trend is predicted. The situation in the German Federal Republic and the effect of the shortages on the natural gas market are discussed. Nuclear energy as a possible source is then discussed. The role of coal in providing future gas supplies and the most recent developments in the gasification of coal are discussed. The advantages to be obtained in the gasification of coal using reactor heat and the gasification techniques possible with this heat source are considered. Improvements in the various steps of the gasification process are indicated. A tentative time table for development of a large-scale installation for using reactor heat for coal gasification is presented. (JSR)

17660 RADIOACTIVE WASTES FROM AGR DESIGNED FOR JAPAN. Yamada, M.; Morimoto, T. (Fuji Electric Co. Ltd., Kawasaki, Japan). Fuji Jiho; 45: No. 12, 1018-1023(Dec 1972). (In Japanese).

The production rate of radioactive wastes in a 600 MW(e) AGR was evaluated. Features of the AGR are explained. Three kinds of regulatory values for the allowable release of the radioactive wastes are compared, namely USAEC's "as low as practicable" guide, Japanese regulation, and design target of the present work. Sources of the radioactive wastes are classified into reactor system, cartridge cooling pond (CCP) and decontamination system. Kinds and quantity of the radioactive wastes and methods of disposal are explained for each category, using a chart of disposal system. Release rate of the gas, liquid and solid radioactive wastes are analyzed and evaluated. Operational conditions and equations for calculation are also given. The expected release of the radioactive wastes from the AGR is compared with that of PWRs and BWRs. The comparison is made on rare gases, iodine, liquid other than tritium, tritium and solids. (JA)

17661 LARGE-SCALE HIGH-TEMPERATURE HELIUM GAS LOOP. Nakano, T. (Kawasaki Heavy Industries, Ltd., Kobe, Japan); Shimomura, H.; Hagiwara, I.; Suzuki, N.; Shinomiya, Y. FAPIG (Tokyo); No. 68, 216-223(Feb 1973). (In Japanese).

As a part of the efforts to develop a multi-purpose high-temperature gas cooled reactor, a large-scale high-temperature helium gas loop was designed and constructed to attain pressure and temperature conditions of 40 kg/cm^{2}g and 1,000°C respectively. It consists of the systems for main circulation, supply, exhaust and recovery, cooling water, instrumentation, and power supply. The main components are: a compressor, a heater, a regenerative heat-exchanger, a high-temperature double-walled tube, and a helium purifier. In the heater, a tantalum pipe is used as a heater element, which is connected to the double-walled tube for helium circulation. The regenerative heat-exchanger is a U-type double-walled tube. (JA)

17662 TECHNICAL PROBLEMS OF HTGR IN JAPAN. Shimokawa, J.; Yasuno, T. (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 19: No. 8, 15-24(Aug 1973). (In Japanese).

The high outlet temperature of coolant from a HTGR, as compared with that of conventional water-cooled reactors, presents the feasibility of not only a power plant of higher thermal efficiency, but also utilization of heat energy in iron smelting. The developmental efforts in Japan, especially in the latter aspect, are described as follows: the course of HTGR development; high-temperature technology for HTGRs, including coated particle fuel, graphite and other structural materials, core structure, etc.; and the utilization of HTGRs for purposes such as iron smelting. The coolant temperature currently available from HTGRs is about 850°C. The outlet temperature of He-coolant must be increased to about 1,000°C, for example, for iron smelting. The process of iron smelting conceived at present is to first produce reducing gas (H_2 and CO) with steam generated by high-temperature helium gas from HTGRs, and then to heat the gas for the reduction of iron ore. (JA)

17663 TRIAL MANUFACTURE OF NUCLEAR FUEL FOR HIGH TEMPERATURE GAS-COOLED REACTORS. II. Manabe, G.; Kai, H. (Furukawa Electric Co. Ltd., Tokyo). FAPIG (Tokyo); No. 66, 97-102(Aug 1972). (In Japanese).

Quadruplex coated particles which show promise as nuclear fuel for a 50 MW experimental gas-cooled reactor and trial manufacture of fuel pellets made of the coated particles by overcoat press method are described. A coated fuel particle has a spherical fuel core with diameter of 500 microns. The fuel core of UO_2 was experimentally manufactured by wet precipitation method. The original fluid, composed of 0.5 to 0.7 mol per liter uranium nitrate, caking agent of 5 to 10 gram per liter, and 4 HF was dripped into ammonia solvent, and turned into spherical precipitation particles. The spherical precipitation particles were turned into 1000 micron ADU, and successively into UO_3 by sintering, and lastly into 500 micron spherical UO_2 by sintering in an atmosphere of hydrogen. As fuel for gas-cooled reactors with a gas outlet temperature of 1000°C, the quadruplex coated fuel particles seem to be promising. In order to get rid of the defects of fuel pellet manufacturing methods employing hot or cold pressing, hot extrusion, and injection molding, the overcoating method was developed. The practicality of this method was demonstrated during the manufacture of the spherical fuel for the AVR in Germany and the fuel pellets for the Dragon reactor in England. (JA)

17664 R AND D ON MULTI-PURPOSE USES OF LWR AND HTR MAKES PROGRESS. At. Jap.; 17: No. 9, 9-13(Sep 1973).

The multi-purpose utilization of HTGRs and also LWRs has been increasingly highlighted recently in Japan on account of the current energy crisis and environmental protection. The efforts by various agencies to study this utilization are described. In this field, a major role is played by high-temperature gas cooled reactors (HTGR), which are being studied primarily by the Japan Atomic Energy Research Institute. Research and development for HTGRs, calculational codes, coated particle fuel, graphite and other metallic structural materials, and experimental gas loops were discussed in reports presented at a meeting. (JA)

17665 TRIAL DESIGN OF THE LARGE MULTIPURPOSE HIGH TEMPERATURE GAS COOLED REACTOR SYSTEM. Tsunoda, R. (Fuji Electric Co. Ltd., Tokyo). Fuji Jiho; 46: No. 11, 954-966(Nov 1973). (In Japanese).

The design of a nuclear iron smelting pilot plant utilizing a high-temperature gas cooled reactor is described from the following standpoints: reactor-core structures, fuel elements, the concrete pressure vessel, refueling, power generation, the intermediate heat exchanger, the reducing furnace, raw material for reducing-gas, modifier, control and instrumentation, and safety design. The plant utilizes a He-cooled HTGR of 3,000 MWth, with a coolant outlet temperature of 1,000°C. The plant is a direct reduction type with a crude steel production capacity of 6,300,000 tons per year, using mixed H_2–CO produced from naphtha as reducing gas. For the reduction of iron ore, a blast furnace is used. The electric power for the furnace is generated by a steam turbine powered by the reactor. (JA)

17666 MULTI-PURPOSE USES OF HTGR. Shimada, H. (Agency of Industrial Science and Tech., Tokyo). Genshiryoku Kogyo; 19: No. 8, 41-46(Aug 1973). (In Japanese).

The high temperatures present in HTGRs present a greater variety of possible applications than other nuclear reactor types; among the possibilities is iron smelting. The development in this field in Japan up to the present is reviewed. The technical matters in the utilization of a multi-purpose HTGR for iron smelting and iron smelting by nuclear energy as a national project are explained. Nuclear energy is utilized in two phases, i.e., the production of reducing gas, and heating the gas produced. A system for nuclear iron smelting using asphalt from petroleum refining as the raw material for the reducing gas is one possibility. As a national project, research and development is proceeding for the establishment of technology for a nuclear iron smelting pilot plant by 1978. In order to attain this objective, research and development of high temperature heat exchangers, heat-resistant super-alloy, heat insulation material for high temperature use, a reducing gas production system, and a reduced iron smelting system is being carried out. On the basis of these results, conditions for optimizing the total system are examined, and the design of a pilot plant is discussed. (JA)

17667 RESULTS OF OPERATIONAL EXPERIENCE AT THE BELOYARSK ATOMIC POWER STATION. Dollezhal, N. A.;

Malyshev, V. M.; Shirokov, S. V.; Emel'yanov, I. Ya.; Saraev, Yu. P.; Aleshchenkov, P. I.; Mityaev, Yu. I.; Snitko, E. I. At. Energ. (USSR); 36: No. 6, 432-438(Jun 1974). (In Russian).

The main results of operational experience at the Kurchatov Atomic Power Station in Beloyarsk are presented. The operation of the evaporator and steam superheater channels, graphite stacking, control and shielding systems, thermomechanical equipment and also computer equipment is considered. A description is given of regimes of partial overloading of fuel channels at the station, chemical water regime, radiation fields, and engineering and economic indicators. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 17973 and 17975.

17668 (CONF-721018-(Vol. 3), pp 1047-1063) NEUTRON SHIELDING STUDY FOR A HEAVY WATER PRESSURE TUBE REACTOR. Boldori, P. (CISE, Milan); Giorcelli, M.; Lauer, H.; Nicks, R.; Penkuhn, H.; Perlini, G.; Ponti, C. 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The results are presented of a study performed for the design of the neutron shield of the prototype CIRENE reactor, which is a heavy water pressure tube reactor. The attenuation properties of this shield have been experimentally investigated with a few mock-ups which have been irradiated in the EURACOS facility. This experience served the purpose of testing several codes and of choosing and implementing a method of calculation suitable to the neutron shield of the reactor. Furthermore the experience points out the main features of the neutron transport along an iron cylinder surrounded by water, and provides useful information to the shield design. (11 references) (auth)

17669 ONTARIO HYDRO FUEL PERFORMANCE. Fanjoy, G. R. (Ontario Hydro, Toronto). Trans. Amer. Nucl. Soc.; 18: 247(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17670 OUTLINE OF EXPERIMENT ON THE SHIELDING PLUG FOR FUGEN. Hayashi, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Nakayasu, F.; Furuta, Y. Doryokuro Giho; No. 7, 69-77(Apr 1973). (In Japanese).

The core of the advanced thermal reactor "FUGEN" consists of a heavy water tank and many pressure pipes which contain fuel assemblies. Fuel exchanging is performed from the bottom of the pressure pipes, so workers must enter into the lower part of the core for the maintenance and inspection of a fuel exchanging machine and for the monitoring of the pressure pipes. Therefore on both upper and lower parts of the core, the shielding structures of water and steel multilayer are installed. Furthermore on both upper and lower portions of the fuel assemblies, shielding plugs are fitted, because extended parts of the pressure pipes penetrate the water and steel multilayer. But adequate calculating formula is not yet established for the case that the plugs are inserted into cylindrical ducts, therefore real-size experiment was carried out and the form and dimensions of the plugs were decided. To human-body, gamma ray from the fuel assemblies and from the pressure pipes is most important problem. The simulation experiments on the gamma ray from fuel assemblies and from pressure pipes were performed with a thermo-luminescence dosimeter (LiF) for the radiation dose measurement of the gamma ray. As a result, the attenuation of radiation with the shielding plugs was one place higher than that without the plugs. But clear difference was not found between the shielding plugs with grooves and those without grooves. (JA)

17671 RESEARCH AND DEVELOPMENT OF FAILED FUEL DETECTION SYSTEM FOR ADVANCED THERMAL REACTOR. Nakano, M.; Kaneko, Y. (Fuji Electric Co., Ltd., Tokyo). Fuji Jiho; 46: No. 4, 397-401(Apr 1973). (In Japanese).

A failed fuel detection system was developed for detecting both fuel failure and the position of a failed channel in the reactor core of an advanced thermal reactor. The precipitation method was employed. Water samples from each outlet channel are sent to a flush tank, and a precipitator detects the existence of any rare gases present as a result of fuel element failure. The precipitation method has the characteristics of high sensitivity and short measuring time. The test equipment simulates the prototype advanced thermal reactor "Fugen", and includes a radioisotope injection system to inject radioactive rare gases. The test equipment is separated into a two-phase flow and carrier gas system. Helium was employed as carrier gas. Development tests were performed in three stages; a system operation test, a performance test, and an endurance test. As a result, it was recognized that the system was able to operate stably, and the condition of precipitator inlet flow was also satisfactory. In the performance test, the time required for the rare gases to reach the detector was much longer than that expected. (JA)

Power Reactors, Breeding

Refer also to abstracts 16132, 16133, 16137, 16185, 17802, 17803, 17808, 17812–17814, 17827, 17828, 17830, 17832–17834, 17837–17842, 17854, 17855, 17857, 17859, 17861, 17862, 17875, 17876, 17890, 17971, and 17995.

17672 (AEEW-R-893) INTERPRETATION OF MEASUREMENTS IN ZEBRA CORE 8. Wardleworth, D. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Oct 1973. 54p. Dep. NTIS (US Sales Only) $5.75.

The Zebra 8 series of assemblies consisted of test regions with k-infinity close to unity, surrounded by an enriched uranium driver and natural uranium blanket. Measurements were made of k-infinity of the test region, using the null-reactivity technique, and cell-average reaction rate ratios at the center of the test region. The aim was to provide well-defined integral checks of the nuclear data used in fast reactor calculations. The derivation of k-infinity from the measurements made, including the effects of heterogeneity, and the correction of the reaction rate ratios to the infinite lattice situation are described. The accuracy of the procedures adopted is estimated. (auth)

17673 (ANL-8063) POSTIRRADIATION EXAMINATION OF A MIXED-OXIDE FUEL ELEMENT IRRADIATED TO END-OF-LIFE CONDITIONS IN SUBASSEMBLY X106 IN EBR-II. Claar, T. D.; Beck, W. N.; Honekamp, J. R. (Argonne National Lab., Ill. (USA)). Dec 1973. Contract W-31-109-Eng-38. 58p. AT.

Seven elements containing UO_2–20 wt % PuO_2 fuel 93% enriched in ^{235}U were irradiated in fail-safe subassembly X106 in EBR-II until a defect developed in the stainless steel cladding of one element that had reached a burnup of about 7 at.%. The loss of cladding integrity was detected by monitoring the fission gases released from the element plenum to the EBR-II cover gas. In postirradiation examination, the defective element was identified by gamma scans for ^{133}Xe in the gas-plenum volume, by change in weight, and by change in balance point. The fission-gas release was benign in that no damage was visually apparent on the adjacent elements. The location of the defect could not be determined by standard visual examination, but was found by internally pressurizing the element with helium while it was immersed in an alcohol bath. Detailed destructive examinations of the element and of an intact sister element were performed to determine the nature and cause of the cladding failure. Evidence gathered during the investigation suggests that the cladding degradation was caused by introduction of a chlorine-containing contaminant into the fuel element during fabrication. Therefore, the failure was atypical of those expected to be encountered in LMFBR mixed-oxide fuel elements. (auth)

17674 (ANL-CT-74-16) THERMAL RATCHETING OF A BEAM. Mulcahy, T. M. (Argonne National Lab., Ill. (USA)). May 1974. 31p. Dep. NTIS $4.75.

Thermal ratcheting has been analytically investigated for a beam subjected to a linear temperature variation across its solid rectangular cross section. A linear strain-hardening material response exhibiting an idealized Bauschinger effect was assumed. Formulas are given for the associated strain accumulation which are valid over a large range of strain hardening, temperature variation, temperature cycles, and axial load. Specific results are tabulated for the materials and operating conditions typically associated with liquid metal breeder reactors. (auth)

17675 (CEA-CONF-2579) S W E TESTING ON REACTOR PHENIX. Tomachevsky, E. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1973. 5p. (CONF-7309109-1). Dep. NTIS (US Sales Only) $4.00.

From meeting of the European group on sonic emission constraints, Frankfurt, Germany, 25 September 1973.

Stress wave emission tests were carried out on the Phenix main vessel in order to investigate the possibilities of the method. (auth)

17676 (CONF-721018-(Vol.1), pp 41-57) INVESTIGATION OF INTRA-VESSEL SHIELDING FOR THE BN-600 REACTOR ON THE BFS-2 RIG. Bakov, A. T.; Bondarenko, V. V.; Voropaev, A. I.; Efimov, E. F.; Kazanskii, Yu. A.; Kulakovskii, M. Ya.; Savitskii, V. I.; Troyanov, M. F.; Fomenko, V. P.; Khokhlov, G. N. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The intra-vessel shielding of the BN-600 reactor consists of a set of steel plates adjacent to the core and several rows of vertical steel tubes filled with graphite in the peripheral part of the shielding. Experiments carried out on the BFS-2 rig to investigate heterogeneity effects in the tube section of the shielding are described. Calculated data on space-energy neutron flux distributions are also presented and compared with experimental results. 4 references. (auth)

17677 (CONF-721018-(Vol.1), pp 58-67) SHIELDING CONCEPTS FOR THE PHENIX REACTOR. Culambourg, J. (CEN, Saclay, France); Devillers, C.; Le Dieu de Ville, A.; Nimal, J. C. 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The shielding studies during the development of Phénix reactor are reviewed. 7 references. (auth)

17678 (CONF-721018-(Vol.1), pp 68-86) SHIELDING OF COMMERCIAL FAST REACTORS. Brindley, K. W. (United Kingdom Atomic Energy Authority, Risley, Eng.). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Shielding problems encountered during the design of the 250 MW(e) PFR and 1300 MW(e) CFR are described together with the theoretical and practical methods of solution. Design criteria are given for activation of components in the primary circuit and the secondary coolant, and for irradiation damage to structural materials. Contamination in the primary circuit with fission and corrosion products from the core is taken into account and also the district hazard from the release of secondary sodium. Consideration is given to the problems of shielding irradiated fast reactor fuel. 10 references. (auth)

17679 (CONF-721018-(Vol.1), pp 87-102) SHIELDING PROBLEMS IN THE PEC REACTOR. Cicognani, G. (CNEN, Bologna); Tavoni, R.; Travaglini, N.; Corbo, M.; Farinelli, L.; Tondinelli, L.; Canali, U.; Nicks, R.; Penkuhn, H.; Ponti, C. 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The PEC reactor is a sodium cooled fast reactor designed mainly for testing fast reactor fuel elements. Its peculiar geometry, also due to the presence of the test zone, originates some particular shielding problems, besides those typical of sodium cooled fast reactors. The problems encountered in the design of the shields of the reactor, the extensive set of calculations that have been performed, and the critical points that have been identified are presented. 12 references. (auth)

17680 (CONF-721018-(Vol.1), pp 104-121) PROBLEMS RELATED TO THE DEFINITION OF THE SHIELDING OF A LARGE FAST POWER REACTOR. Moreau, J. (CEN, Cadarache, France). 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Solutions for the shielding of a 1000 MW(e) power plant in the same technological line as Phénix are given. They have been evaluated with a monodimensional transport code. The choice is based on the comparison of their efficiency toward neutrons and on the consequences of their characteristics on the conception of the reactor tank. A few economical considerations give an idea on the influence of the choice in shielding on the cost of the power plant. At last, the problem of the optimization possibilities is approached from the designer's point of view. (auth)

17681 (CONF-721018-(Vol.1), pp 122-135) GAS-COOLED FAST REACTOR SHIELD DESIGN. Haschke, D.; Ganapol, B.; Henninger, R.; Maeder, C. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

A design approach for the internal radial neutron shield for a gas-cooled fast reactor is presented. Models of embrittlement and their use, accuracy of various approximations for determining the neutron flux, the effect of different shielding materials and various configurations, and some economic aspects are discussed. 9 references. (auth)

17682 (CONF-721018-(Vol.2), pp 611-624) DEVELOPMENT OF THE TWO-DIMENSIONAL SHIELDING CODE RASC-2D AND ITS APPLICATION. Tanaka, Y.; Suzuki, I.; Ohtani, N. (Kawasaki Heavy Industries, Ltd., Tokyo). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The two-dimensional shielding code RASC-2D is described. The code which is based on the removal-diffusion theory has been developed for the analysis of LMFBR shields taking into account of (1) a-few-group approximation, (2) suitable treatment of fission sources, and (3) empirical adjustment of removal cross-sections. Its usefulness with the practical computing time and the reasonable accuracy is shown in the application to the "JOYO" main shield. 11 references. (auth)

17683 (CONF-721018-(Vol. 3), pp 664-681) EFFECTS OF NEUTRON IRRADIATION ON MATERIALS INTENDED FOR SHIELDING NUCLEAR REACTORS. Yvars, M.; Degas, P.; Quetier, M.; Rousseau, G. (CEN de Saclay, Gif-sur-Yvette, France). 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Different types of materials, as graphite, absorbing and unabsorbing graphitic carbons, boron carbide, have been developed for the shielding of fast neutron reactors. Their use has also been considered for other types of reactors, in particular high temperature reactors. Physicochemical properties of these materials, their composition, mechanical and thermal characteristics, desorption of occluded gases versus temperature are examined, as well as thermal shock properties of sintered boron carbides. Furthermore, the behavior of these different materials in molten sodium at 600°C has been examined with respect to the shielding of fast neutron reactors. Finally, all modifications of these properties, caused by neutron irradiation at 600°C and doses of about 8.10^{21} n.cm^{-2} (E > 0.1 MeV) are given. (3 references) (auth)

17684 (CONF-721018-(Vol. 3), pp 788-809) LMFBR RADIATION TRANSPORT METHODS DEVELOPMENT. Mynatt, F. R.; Gritzner, M. L.; Williams, L. R.; Clifford, C. E. (Oak Ridge National Lab., TN). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The elements of a shielding program based on a fundamental approach are discussed with a brief evaluation of the present status of the technology. A procedure is presented for utilizing the best features of Monte Carlo, discrete ordinates, and diffusion theory in coupled calculations providing good accuracy at minimum expense. As an example, results are presented from a four-step coupled two-dimensional discrete ordinates calculation for determination of the neutron and secondary gamma-ray dose rates in the FTR head compartment. An assessment of computational methods development plans is presented. (40 references) (auth)

17685 (CONF-721018-(Vol. 3), pp 881-897) ACTIVITY AND SHIELDING OF THE BLANKET GAS CIRCUIT OF A FAST POWER REACTOR. Costa, L.; de Fremont, R. (CEN, Cadarache, France). 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The activity of rare gas fission products in the blanket gas of a fast power reactor is calculated for the main operating conditions, taking into account the presence in the core of a certain amount of cladding failures. The corresponding shielding is calculated. The analysis of the results shows the main consequences of rare gas contamination on the conception of the blanket gas circuit and on the allowable amount of cladding failures in the case of a "clean" reactor. (auth)

17686 (CONF-721018-(Vol. 3), pp 923-936) SHIELDING OF FUEL HANDLING INSTALLATIONS AND AUXILIARY CIRCUITS OF THE PHENIX REACTOR. Culambourg, J. (CEN de Saclay, Gif-sur-Yvette, France); Godot, B.; Jegu, J. 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Solution of the shielding problems in the PHENIX reactor design is reviewed. After giving the strength of various radioactivity sources, fuel handling through a shielded lock chamber, exchangers, pumps, transfer arm and control rods mechanisms handling in two shielded mobile casks is described. Shielding, running and maintaining the circuits for purification of sodium coolant and for purification of the argon plenum are outlined. (auth)

17687 (CONF-721018-(Vol. 3), pp 1148-1165) NEUTRON STREAMING ALONG THE PENETRATION OF A TWICE BENT SODIUM PIPE. Dietrich, O. (EURATOM-CCR, Ispra, Italy); Marchal, A.; Nicks, R.; Perlini, G.; Mueller, K.; Vossebrecker, H.; Oliva, A. 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Measurements and Monte Carlo calculations on the neutron attenuation along a large twice bent sodium pipe penetration through graphite and concrete shields which is typical for loop type LMFBR's are presented. The agreement between the mea-

sured and calculated flux-densities is satisfactory both for the TIMOC 71-code and for the ALBEMO-code (based on the albedo-concept). (9 references) (auth)

17688 (COO-2109-8) ANALYTICAL STRESS ANALYSIS SOLUTION FOR A SIMPLIFIED MODEL OF A REACTOR FUEL ELEMENT. Final Report. Lamkin, D. E. (Arizona Univ., Tucson (USA). Engineering Experiment Station). May 1974. Contract AT(11-1)-2109. 110p. Dep. NTIS $8.50.

A simplified mathematical model for fuel element stress analysis was considered. The principal idealizations introduced were: (1) the fuel element was represented geometrically by one fuel region surrounded by a cladding region, (2) mechanical properties were taken to be space independent within each of the two regions, (3) creep rates were assumed to be related linearly to the deviatoric stress, and (4) a state of plane strain with azimuthal symmetry was assumed. Using the method of the viscoelastic-elastic analogy, closed-form analytical solutions to this model were obtained giving the stresses in the fuel element. Based upon this analytical solution, a numerical evaluation of the cladding stresses for a typical LMFBR fuel element was obtained. For the properties and geometry selected, no fuel-cladding interaction was indicated. The major stress producing mechanism was identified to be the spatial variation of the stainless steel swelling through the cladding wall. It was found that irradiation creep produces a considerable relaxation of the cladding stresses. In order to examine the effect of a fuel-cladding interaction pressure, a second numerical evaluation was carried out with a lower fluence to burnup ratio, resulting in much higher cladding stresses. (auth)

17689 (EURFNR-1173) MECHANICAL PROPERTIES OF CLADDING MATERIALS AFTER ANNEALING WITH CARBIDE FUELS. Gotzmann, O.; Hofmann, P.; Sarikaya, Y. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Oct 1973. 30p. (KFK-1942). Dep. NTIS (U. S. Sales Only) $4.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Carburization of the cladding material is the only critical chemical interaction between fuel and cladding that is to be expected in a carbide pin. Carburization greatly affects the mechanical properties of the cladding material. The mechanical properties of the steels (elasticity and tensile strength) are most affected when annealed with carbide fuels at 600°C. At 500°C, carburization is still low. At higher temperatures (above 700°C) a resolution of carbide precipitates takes place. Fuel composition and bonding medium have a marked influence on the mechanical properties. Room temperature elongation values for steel as well as for vanadium base alloy specimens annealed at 600°C are very low. With sodium bonding they drop to practically zero. However, elongation values at higher temperatures are still satisfactory. Hardness measurements, mechanical properties, and carbon contents of the cladding materials after annealing can be related. (auth)

17690 (HEDL-TME-74-13) IN-SODIUM TESTS OF MICROWAVE FREQUENCY PRESSURE/TEMPERATURE SENSOR. Billeter, T. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Apr 1974. Contract AT(45-1)-2170. 34p. Dep. NTIS $4.00.

A sensor for the measurement of pressure and temperature and operated at microwave frequencies was tested in liquid sodium. Operational characteristics of the sensor and associated instrumentation was determined over a temperature range of 350 to 1100°F and over a pressure range from atmospheric to 190 psia. Time response of the unit for pressure transients was also ascertained. Total duration of the test approximated 350 hours. 9 references. (auth)

17691 (IAEA-PL-504-1) EXPERIENCE AND TECHNIQUES IN MAINTENANCE AND REPAIR OF REACTOR COMPONENTS ON THE DOUNREAY FAST REACTOR. Kirk, J. (International Atomic Energy Agency, Vienna (Austria)). 1972. 14p. INIS.

Since the DFR first went critical in 1959, a considerable amount of radioactive maintenance has been carried out. The work has ranged from relatively minor tasks such as control rod maintenance to major undertakings like the changing of the complete core tube nest, dealing with 600 swollen breeder elements and repair of a primary circuit leak. The techniques employed in carrying out the maintenance are described. (INIS)

17692 (JAERI-M-5449) EFFECTS OF FISSION PRODUCTS ON THE PHYSICS PARAMETERS OF LARGE FAST REACTORS AND UNCERTAINTIES IN THE PHYSICS PARAMETERS DUE TO THE FISSION-PRODUCT NUCLEAR DATA UNCERTAINTIES. Tone, T. (Japan Atomic Energy Research Inst., Tokyo). Nov 1973. 62p. INIS.

The effects of fission products accumulating with fuel burnup on the physics parameters of large fast reactors have been investigated. The effects on the effective multiplication factor, the sodium void reactivity and the transformation of fuel composition at a specific burnup do not depend on the history, but almost entirely on the amount of fission products accumulated by that time. The effect on the internal breeding ratio is insignificant. The effect on the effective delayed neutron fraction is only slight, while that on the prompt-neutron lifetime is appreciably large. The uncertainties in the currently available radiative capture cross section and yield data of fission products and the influences on the effective multiplication factor and the sodium void reactivity are also discussed. The uncertainties in radiative capture cross sections of the individual fission product nuclides are reduced considerably by cancellation resulting from their lumping. The uncertainty in the lumped radiative capture cross sections of ^{235}U-FP is about 10%, while those for other fissile elements are about 3.5%. The uncertainties in ^{239}Pu-FP, for example, produce about a 0.2% reactivity uncertainty in the effective multiplication factor and the sodium void reactivity, respectively, in large fast reactors at high burnup. Various sets of the lumped group radiative capture cross sections calculated for the different fission-product nuclear data are given. (auth)

17693 (KFK-1273/4) FAST BREEDER PROJECT. Fourth Quarterly Report, 1973. (Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Schneller Brueter). Mar 1974. 201p. (In German). (EUR-4974-d). Dep. NTIS (U. S. Sales Only) $13.25.

An account of investigations carried out by several institutes of the GfK in Karlsruhe and of work performed under contract is given. The subjects covered are: fuel rod development, materials testing and development, corrosion tests and coolant analyses, fuel cycle studies, physics, safety, instrumentation, and sodium technology investigations. (GE)

17694 (KFK-1831) INVESTIGATIONS ON THE REACTION BEHAVIOR OF STEELS WITH SIMULATED FISSION PRODUCTS IN THE PRESENCE OF UO_2, $(U,Pu)O_2$, AND UC AND POSSIBILITIES TO IMPROVE THE COMPATIBILITY BEHAVIOUR OF OXIDE FUEL PINS. Hofmann, P. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Mar 1974. 234p. (In German). Dep. NTIS (U. S. Sales Only) $14.75.

The reaction behavior of uranium oxide, uranium plutonium mixed oxide, and uranium carbide in the presence and absence of simulated fission products with austenitic stainless steels was investigated. First, an assessment of the compatibility conditions in the various cladding material-fuel-fission product systems was made using available thermodynamic data. Out-of-pile compatibility tests were performed with the thermodynamically instable systems with test temperatures between 200 and 1000°C and annealing periods between 10 and 3000 h. The simulated burnup was 10 and 20 at. %. As cladding materials the austenitic steels 1.4401, 1.4541, 1.4970, 1.4981, and 1.4988 were tested. Of the approximately 30 fission product elements in the fuel during irradiation, only the elements Cs, Rb, I, Br, Te, and Se react with the steels if an oxide fuel is used. The reaction behavior of part of these fission products is strongly dependent on the oxygen potential in the system in addition to time and temperature. With increasing O/M ratio of the fuel, the amount of reaction with the steels increases. With hyperstoichiometric oxide fuel, Cs proved to be the most dangerous fission product; with substoichiometric fuel Te did so. Chemical reactions of the simulated burnup systems with the cladding materials begin at 400°C. The kinetic evaluation of the fission product reactions with steels results in a parabolic time law for the cladding attack at temperatures up to 700°C (n = 0.5). Above 700°C, the exponent n of the time law decreases from 0.5 to 0.2 and 0.3. With fuel O/M ratios below 2.00, only weak reaction of the fission products with the steels can be observed even at 800°C. Thus, oxygen getters in the fuel pin may be used to prevent dangerous Cs reactions with the cladding. Two methods of inserting getters were investigated: local getters (Ti, Zr) and inner coating of the tube (Nb). With carbide fuel, the fission products do not determine the compatibility with the steels but only the carbon potential of the fuel. Only a carburization of the cladding takes place which is not influenced by the fission products. In the carbide fuel the fission products react only with themselves or with the UC or (U,Pu)C. The use of carbide fuel in fast breeder reactors therefore is advantageous with respect to the compatibility behavior especially at high temperatures and burnup. (55 references, 219 figures) (auth)

17695 (NP-20046) DISASSEMBLY AND EXAMINATION OF SRE SODIUM HEATED STEAM GENERATOR. Report 7978. Cobb, R. V.; Ferguson, K. M. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). 11 Jan 1971. 75p.

The results of destructive testing performed on the steam generator used in the Sodium Reactor Experiment are reported. The testing was carried out to determine the effects of sodium and mercury on the Type 304 stainless steel used in fabricating the component. The examination included visual inspection, metallurgical studies, and chemical analysis. No serious degradation of the material of construction was observed. (DG)

17696 (ORNL-SUB-3754-1) ELEVATED TEMPERATURE ELASTIC-PLASTIC-CREEP TEST OF STIFFENED SHEAR-LAG PANEL. Final Report. Egger, R. L. (Boeing Aerospace Co., Kent, Wash. (USA)). Feb 1974. Subcontract 3754. 251p. Dep. NTIS $7.60.

For Oak Ridge National Lab., Tenn.

A test program is described, the purposes of which were to provide elastic-plastic-creep structural test data for comparison with inelastic analysis predictions, and to demonstrate the capabilities of a Boeing high-temperature capacitive strain gage as a long-term stable strain-measuring device. The test specimen used was a shear-lag structure consisting of a thin, square, stainless-steel plate loaded in its plane through tapered stiffeners. A shear-lag specimen was instrumented with ten capacitive strain gages, heated to 1100°F and subjected to long-term tensile and compressive loads. The capacitive strain gage data from the long-term test are presented and discussed. In addition to the shear-lag specimen test data, appendices are included containing the material property data needed by an analyst for making analytical predictions for comparison with the test results. (auth)

17697 (PNCT-831-73-2) TOKAI WORKS SEMI-ANNUAL PROGRESS REPORT, JANUARY–JUNE 1973. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Dec 1973. 122p. Dep. NTIS (U. S. Sales Only) $9.25.

Research progress during the first half of 1973 is summarized. The work included the development of processing and accounting procedures for plutonium fuel fabrication facilities, the test fabrication of mixed oxide fuel pellets and fuel assemblies for JOYO, materials testing of UO_2 pellets, analysis of molten fuel-sodium interactions, and inspection and testing of FBR fuel pin cladding. (JWR)

17698 (STI/PUB-346(Vol.1)) FUEL AND FUEL ELEMENTS FOR FAST REACTORS. Volume I. Conference Held at Brussels, Belgium, July 2–6, 1973. Proceedings Series. (International Atomic Energy Agency, Vienna (Austria)). Feb 1974. 415p. (In Several Languages). (CONF-730726-P1). IAEA $18.00.

Twenty-four papers are included in this volume, arranged under the following section headings: fuel materials, fuel pin irradiation, fuel–cladding and fuel–coolant reactions, and design and validity. A separate abstract was prepared for each paper. (DLC)

For abstracts of individual papers see: 16132, 16133, 16181–16185, 17722–17735, 17775, 17962, and 17963.

17699 COMPUTER SIMULATION OF RADIOACTIVE CORROSION PRODUCT TRANSPORT IN THE LMFBR. Cooper, M. H.; Taylor, G. R. (Westinghouse Electric Corp., Madison). Trans. Amer. Nucl. Soc.; 18: 104-105(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17700 FISSION GAS RELEASE AND TRANSPORT MEASUREMENTS IN A VENTED GCFR FUEL ROD IRRADIATION. Campana, R. J. (General Atomic Co., San Diego, CA); Lindgren, J. R.; Longest, A. W.; Strain, R. Trans. Amer. Nucl. Soc.; 18: 124-125 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17701 APPLICATION OF STATISTICAL ANALYSIS TO CLADDING FAILURE IN A MULTIPARAMETER IRRADIATION PROGRAM. Hofman, G. L.; Johnson, D. L.; Greenberg, S.; Brown, F. L. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 125-126(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17702 MODELING TRANSIENT FISSION GAS RELEASE FROM OXIDE FUEL. Gruber, E. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 126(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17703 USE OF THORIUM–METAL BLANKETS IN FAST BREEDER REACTORS. Faya, A. J. G. (Cidade Univ., Sao Paulo, Brazil); Oosterkamp, W. J.; Faya, S. C. S. Trans. Amer. Nucl. Soc.; 18: 181-182(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17704 THORIUM BLANKETS IN GAS-COOLED FAST BREEDER REACTORS. Cerbone, R. J. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 182-183(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17705 INCIPIENT BOILING SUPERHEAT MEASUREMENTS AT LMFBR CONDITIONS. France, D. M.; Carlson, R. D.; Rohde, R. R.; Charmoli, G. T. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 202(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17706 THERMODYNAMIC LIMIT OF SUPERHEAT OF SODIUM. Eberhart, J. G. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 202-203(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17707 FAILURE MODES OF IRRADIATED LMFBR FUEL PINS DURING TRANSIENTS. Madrid, A.; Sun, Y.; Cermak, J. O.; Okrent, D. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 18: 203-204(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17708 PRESSURE DECAY AND FISSION GAS RELEASE RATES FOR LMFBR FUEL PINS. Misra, B.; Crawford, R. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 204-205(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17709 DROPLET SIZES RESULTING FROM BREAKUP OF LIQUID AT GAS-LIQUID INTERFACES OF LIQUID-SUBMERGED SUBSONIC AND SONIC GAS JETS. Chawla, T. C. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 205-206 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17710 REACTIVITY EFFECTS IN THE GAS-COOLED FAST BREEDER REACTOR (GCFR). Torri, A. (General Atomic Co., San Diego, CA); Driscoll, M. J. Trans. Amer. Nucl. Soc.; 18: 224-225(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17711 PRELIMINARY DESIGN OF THE GCFR FUEL ELEMENT. Ream, J. T.; Weinberg, A. F.; Snyder, H. J. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 275-276(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17712 EFFECT OF MECHANICAL INTERACTIONS BETWEEN FUEL ROD AND SPACER GRIDS IN GCFR ELEMENT. Flynn, P. W.; Ream, J. T.; Weinberg, A. F. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 276(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17713 EXPERIMENTAL MIXING STUDIES WITH A 91-ELEMENT SIMULATED LMFBR FUEL ASSEMBLY. Lorenz, J. J. (Argonne National Lab., IL). Ginsberg, T.; Morris, R. A. Trans. Amer. Nucl. Soc.; 18: 276-277(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17714 CARBIDE RADIAL BLANKET FOR A DEMONSTRATION LMFBR. Capersson, S. A. (Combustion Engineering, Inc., Windsor, CT); Metevia, W. J.; Stuteville, D. W.; Noyes, R. C.; Vitti, J. A. Trans. Amer. Nucl. Soc.; 18: 277-278(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17715 SPACE-DEPENDENT CROSS SECTIONS FOR ANALYZING MULTIPIN LMFBR SAFETY TESTS. Kier, P. H.; Shaftman, D. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 315(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17716 COARSE MESH CORRECTION FOR FINITE DIFFERENCE METHOD ON DIFFUSION CALCULATION. Kato, Y.; Takeda, T.; Takeda, S. (Hitachi Ltd., Kanagawa, Japan). Trans. Amer. Nucl. Soc.; 18: 321-322(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17717 EFFECT OF DIFFERENCES IN FISSION PRODUCT CROSS-SECTIONS LIBRARIES ON k_{eff} AND Na-VOID COEFFICIENT CALCULATION. Ilberg, D.; Saphier, D.; Yiftah, S. (Soreq Nuclear Research Centre, Yavne, Israel). Trans. Amer. Nucl. Soc.; 18: 329-330 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17718 SURVEY OF SENSITIVITY ANALYSIS FOR APPLICATION TO CRBRP NUCLEAR DESIGN. Buhl, A. R. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 335-336 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17719 GENERALIZED REACTOR SENSITIVITY ANALYSIS PROGRAM AT ORNL. Silver, E. G. (Oak Ridge National Lab., TN); Oblow, E. M.; Kalfelz, J. M.; Weisbin, C. R.; Bartine, D. E.; Flanagan, G. F.; Mynatt, F. R. Trans. Amer. Nucl. Soc.; 18: 341-342 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17720 IKRD MEASUREMENTS WITH A MOCKUP OF CRBR SHIELD. Bullock, J. B.; Mihalczo, J. T.; Mathis, M. V. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 347-348 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17721 NUCLEAR FUEL DESIGN FOR FAST BREEDER REACTORS. Oono, T. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). Genshiryoku Kogyo; 19: No. 2, 25-29 (Feb 1973). (In Japanese).

Special features of the nuclear fuel design for fast breeder reactors are discussed from the viewpoints of high temperature, high heat flux, high fast neutron irradiation and use of sodium coolant. As the problem associated with high temperature, importance of the mechanical strength of cladding material is explained in connection with high burnup. The results of high temperature (600°C ~ 750°C) creep rupture tests performed on the fuel cladding tubes of JOYO are shown. Remarkable decrease of creep rupture strength due to inner pressure at the temperature above 650°C, which is the design temperature for JOYO, is pointed out. Evaluation of hot-spot temperature and rate of F.P. gas release are also discussed. As for the high heat flux, the problem of thermal ratchet is explained, based on the test performed on SUS 32. The problem of swelling of stainless steel is reviewed from the viewpoints of the change of mechanical performance and volume. As for the use of sodium coolant, summary of the tests on the effect of sodium is given with short comment on the necessity of long-hour corrosion test on blanket fuel. Finally, development of the standard design code for the mechanical design of fuel, such as ASME Sec. III for reactor pressure vessels, is proposed. (JA)

17722 IRRADIATION OF FUEL WITH DENSITIES OF 80% AND 85% IN THE RAPSODIE REACTOR. Carteret, Y.; Conte, M.; Trotabas, M.; Kryger, B.; Lallement, R.; Ratier, J. L. (CEN, Fontenay-aux-Roses, France). pp 17-38 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

Six assemblies of fuel pins (162 in all) containing mixed oxides with sintered densities of 80% and 85% were irradiated in Rapsodie to burnups of 38,000 to 82,000 MW · d/t, the linear power varying at the commencement of irradiation from 185 to 445 W/cm. Non-destructive examinations showed satisfactory behavior of the fuel pins as a whole and of the column of fissile material. Fission gas release varied from 65% to 90% at 38,000 MW · d/t, reaching 90 to 100% at 82,000 MW · d/t. Destructive examinations threw light on the reaction of the fuel to high temperatures: for linear power values above a certain threshold (which varies with the sintered density), the fuel becomes denser and a central hole is formed. The extent of densification increases with the linear power level. At the periphery, a zone with porosity fairly close to the initial porosity was observed, but sometimes much less, and near the center a restructured zone with mean porosity less than the initial porosity. At 38,000 MW · d/t the appearance of the fuel is the same as at the outset. At higher burnups, the structural limits sometimes become very imprecise, so that it is impossible to estimate the fuel temperature. However, there were indications that the temperature must have been high (large releases of fission gases, plutonium migration towards the center). Destructive examinations allowed fuel swelling to be determined. The swelling is accommodated completely by the porosity of the fuel, without the central hole being involved. Considerable deformation of the cladding was observed, due partly to the swelling of the steel and partly to plastic deformation of the cladding which is perhaps related to the pressure exerted by the oxide. (18 figures) (auth)

17723 CALCULATIONS AND ESTIMATES OF CONTRIBUTIONS OF DIFFERENT TRANSPORT MECHANISMS TO FISSION-GAS BEHAVIOR IN FAST BREEDER OXIDE FUEL. Ronchi, C.; Matzke, H. J. (EURATOM, Karlsruhe, Ger.). pp 57-70 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

Much of the available literature on fission-gas behavior in oxide fuel is restricted to one of the possible transport mechanisms only, i.e. to (a) restructuring the fuel by mobility of pores and lenticular voids and connected sweeping phenomena; (b) mobility of fission-gas bubbles; (c) interaction of such bubbles with subgrain boundaries, dislocations etc. and sweeping by these defects; (d) diffusion of dissolved gas atoms to sinks or surfaces; whereas a critical balance of these processes for given operating conditions seems still to be missing. Such a balance is presented for highly rated oxide fast breeder fuel. On the basis of extensive model calculations and careful electron microscope examination of bubbles and pores in such fuels, it is concluded that most of the gas release is due to the diffusion of single gas atoms, whereas the contribution of the remaining transport processes is estimated to be typically $\lesssim$25% of the overall release. This is explained by the fission-induced resolution of gas atoms from bubbles which can be shown to be effective in oxides at all temperatures. The model calculations demonstrate the effect of re-solution on gas release and swelling. The predictions of the model include local and overall gas release, bubble size, and intragranular or microscopic swelling as functions of fuel temperature and burnup. These predictions are shown to be in satisfactory agreement with post-irradiation examinations of fast irradiation experiments. (auth)

17724 FUEL ELEMENT BEHAVIOR UNDER IRRADIATION IN DFR. Bagley, K. O. (United Kingdom Atomic Energy Authority, Dounreay, Eng.); Edmonds, E.; Powell, H. J.; Bellamy, R. G.; Paris, R.; Horspool, J. M. pp 87-100 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

A total of over 1000 stainless steel or nickel alloy clad (U,Pu) oxide and carbide fuel pins have now been irradiated in Dounreay Fast Reactor, the maximum burnup and neutron dose achieved by substantial numbers of pins being ~11.2% of heavy atoms and ~9×10^{22} n · cm^{-2} respectively. These pins effectively represented pin design concepts proposed for large fast reactor systems and were intended to investigate the influence of variations in such parameters as cross section, fuel and clad type composition and condition, fuel-mass rating, maximum clad and fuel temperature on pin performance, endurance limit, and failure characteristics. Data are presented on clad strain development as a function of burnup and neutron dose for different clad and fuel types, and on microstructural changes in fuel and clad. A substantial number of fuel pins incorporating the parameters of the PFR pin design have exceeded 10% burnup max without demonstrating a generic failure mechanism of relevance to power reactors. Post-failure phenomena have therefore been studied by irradiating naturally or artificially defected pins for extended periods, and the contribution of fuel/coolant reactions to rupture initiation or propagation explored. Observations on the frequency and nature of chemical attack on the inner surface of the cladding are made. A number of sodium-bonded carbide pins have been examined after irradiation to various exposures in DFR, and some results are described. The scope and objectives of the experimental fuels irradiation program in the PFR are briefly reviewed. (auth)

17725 BEHAVIOR OF RAPSODIE FUEL ELEMENTS DURING 1971-72. Batier, J. L. (CEN, Cadarache, France); Mercier, C.; Anselin, F. pp 101-109 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

During 1971-72 the Rapsodie reactor operated very satisfactorily. The fuel elements reached burnups of 9 at. % (with corresponding neutron doses of 7 to 8×10^{22} n/cm^2) without rupturing, despite relatively high cladding temperatures (up to 650°C). Results of observations are presented, especially of micrographic examinations of the fuel, analyses of fission gas samples from the fuel pins and measurements of cladding deformation. The empirical laws

which the deformations appear to obey are indicated and conclusions drawn regarding the behavior of the fuel elements of future fast reactors. (auth)

17726 IRRADIATION TESTING IN THE DEVELOPMENT OF FUEL ELEMENTS FOR THE GAS-COOLED FAST BREEDER REACTOR. Lindgren, J. R. (Gulf General Atomic Co., San Diego, CA); Campana, R. J.; Langer, S.; Weinberg, A. F.; Simon, R. H.; Longest, A. W.; Strain, R. pp 111-124 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

The fuel rods for the GCFR are vented through a pressure-equalization system to a helium purification system; thus the pressure differential across the fuel-rod cladding is very small (~40 lbf/in.^{2} (psi)). With this feature, it is possible to make the design of the GCFR fuel rods similar to that of the LMFBR fuel rods. Features related to venting of the fuel rods, such as the use of charcoal traps, and those related to the use of the helium coolant, such as roughening the cladding surface to improve heat transfer to the coolant, are being tested. An irradiation program for the development of fuel elements for the GCFR is being conducted using ORR for thermal-flux irradiation of vented fuel rods and EBR-II for fast-flux irradiation of sealed rods. The irradiation program is a cooperative effort among Gulf General Atomic, Argonne, and ORNL. From results, it can be concluded that the venting of the fuel rods is feasible and the behavior of the gaseous fission products can be predicted analytically. In addition, the volatile fission products have been transported only as far as the fuel end of the blanket. (auth)

17727 PERFORMANCE ASSESSMENT OF FAST REACTOR FUEL IN CADMIUM-SCREENED BR2 IRRADIATION DEVICES. Van Looy, J. (CEN/SCK, Mol, Belgium); Van Massenhove, G.; von der Hardt, P. pp 125-146 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

The Belgian Materials Testing Reactor BR2 is largely used for the irradiation of fissile and structural materials for the fast reactor development program, with particular orientation to the construction of the Debenelux SNR-300. Advantages and drawbacks of epicadmium irradiation testing in a thermal test reactor and representativity for "true" fast flux conditions are reviewed. The difference of neutron spectra between an epicadmium irradiation and a fast core is studied in its influence on fuel temperature distribution, high-temperature embrittlement of the cladding, and swelling and radiation-induced creep of fuel and cladding. Literature and observations in the field indicate that epicadmium irradiation leads to higher cladding stresses than in a fast reactor, for the same fuel burnup, and to earlier clad failure. This conclusion adds to the general opinion that high-flux fast-neutron irradiation space must be made available in the future. Loop and capsule irradiations under cadmium in BR2 are also reviewed. More than 30 mixed oxide fuel pins have been or are being irradiated up to and beyond 100,000 MW · d/t. High-power carbide pins are irradiated between 1000 and 1500 W/cm linear rating. Assessment is emphasized of fuel performance under cadmium by combining in-pile measurements, out-of-pile testing, low-power neutron dosimetry, and feedback information from post-irradiation examination with relevant computer calculations. (5 tables, 11 figures) (auth)

17728 EXPERIMENTAL RESULTS ON THE MECHANICAL INTERACTION BETWEEN OXIDE FUEL AND CLADDING. Bucklacher, D.; Dienst, W. (Kernforschungszentrum, Karlsruhe, Ger.). pp 147-161 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

In fast breeder fuel rods, steady-state interaction between fuel and cladding could be caused by fission-product swelling of the unrestructured outer fuel zone remaining rather cold and free of wide radial cracks. The corresponding oxide fuel swelling and in-pile creep rates were measured for dependence on fission rate, stress, and temperature. From the results, a swelling pressure of only about 10 kgf/cm^2 (at a fuel rod power of 500 W/cm) can be calculated to act on the inner cladding surface. Moreover, a first direct measurement showed the swelling pressure to be below 25 kgf/cm^2. The corresponding cladding stresses are too low to cause very great strains. Therefore the observed cladding strains by mechanical interaction with the fuel must be due to unsteady-state crack-ratcheting processes as a result of rod power changes. However, a power cycling test on short fuel rods yielded no repeated cladding strain in a series of short cycles. On the other hand, fuel rods which had been irradiated to burnups above about 4% showed a continual cladding diameter increase by a strain rate of 0.05% to 0.13%/% burnup. The strain values appeared to increase with the sintered density of the fuel, which was between 84 and 93% TD. The conclusion was drawn that the underlying crack-ratcheting process requires both strong adherence between fuel and cladding and long power cycles for crack blockage. A special type of cladding strain, probably caused by accumulation of volatile fission products, seemed to appear at the hot bottom end of the fuel columns after a rod-bundle irradiation. (auth)

17729 KINETICS OF OXYGEN TRANSPORT FROM MIXED-OXIDE FUEL TO THE CLAD. Bober, M.; Dorner, S.; Schumacher, G. (Kernforschungszentrum, Karlsruhe, Ger.). pp 221-232 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

The reaction of the oxygen of mixed-oxide fuel to the cladding material is divided into three consecutive steps corresponding to three single processes: First, the release of oxygen from the mixed-oxide fuel, which depends on the diffusion in the fuel matrix; second, the transport of oxygen in the gas phase through the peripheral gap determined by the pressure gradients of the carrier gases; and, third, the absorption of oxygen by the clad, which depends on the penetration rate into the cladding material. Experiments are discussed which were made to investigate the rate of each single process as a function of the O/M ratio in the fuel. The result was that the release of oxygen from the fuel is a comparatively rapid process. At O/(U,Pu) ratios above 1.98 in $(U_{0.8},Pu_{0.2})O_{2-x}$, the oxygen transport through the peripheral gap becomes effective while the absorption of oxygen by the clad is the rate-controlling process. It is assumed that carbon oxides are eliminated as carrier gases by reaction to the cladding material and that hydrogen penetrates the clad. Thus, the hydrogen impurities in the coolant, e.g. sodium and helium, determine the gas-phase transport of oxygen. (6 figures, 25 references) (auth)

17730 DESIGN OF OXIDE FUEL FOR FAST REACTORS. Holmes, J. A. G. (Nuclear Power Group Ltd., Risley, Eng.). pp 295-309 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

The factors and limits influencing fast reactor fuel design are discussed. These include fuel linear rating, cladding temperature, fission-gas release, coolant velocity and pressure drop, and selection of structural materials. Within permissible limits which have been determined for these factors, the fuel pin length and diameter are selected so that the resulting design is close to the economic optimum, which depends on economic ground rules and the nuclear system in which the plant is to operate. The optimum design for the United Kingdom system is discussed. The resulting engineering design of fuel for the Prototype Fast Reactor and future commercial reactors and reasons for selection of design features including alternatives under consideration are described. Thermal, hydraulic, and mechanical performance of the design, including the relationship between supporting theoretical and experimental work in predicting fuel behavior, is reviewed. The influence of neutron-induced voidage and irradiation creep on fuel and sub-assembly support system design is considered. (9 figures) (auth)

17731 OUT OF PILE EXPERIMENTS WITH PROTOTYPE FUEL ELEMENTS FOR SNR-300. Jansing, W.; Markfort, D.; Ruppert, E.; Voj, P. (INTERATOM, Bensberg, Germany). pp 311-328 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

The development of a fuel subassembly designed for operation in sodium-cooled fast breeder reactors consists of several steps. Following design and subsidiary experiments, the prototypes are tested in out-of-pile and in-pile experiments. While the results of in-pile tests directly enhance determination of the fuel pin specification, experience gained with out-of-pile tests is essential for defining the overall behavior of the fuel subassembly except for irradiation effects. Main objectives of these experiments pertain to their hydraulic and mechanical behavior. The experimental program contains operations and endurance tests with a prototype fuel subassembly under simulated reactor conditions, including perturbations of all types, except for radiation. The different

stages can be assigned to: hydraulic performance; mechanical and vibrational tests; endurance and functional tests; and handling experiments. The most important experiments and results are presented. The problems and the status of work are discussed. (16 figures) (auth)

17732 THEORETICAL AND EXPERIMENTAL STUDIES SUPPORTING THE DESIGN OF FAST REACTOR FUEL ELEMENTS. Eickhoff, K. G. (United Kingdom Atomic Energy Authority, Risley, Eng.); Betts, C.; Buckley, F. I.; Iliffe, C. E.; McAreavey, G.; Pounder, J. O.; Hughes, H.; White, D. pp 329-349 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

Theoretical methods were developed whereby the effect of various parameters (pin size, pin length, coolant fraction, etc.) on core performance and reactor system economics can be investigated, leading to the selection of an optimized fuel element design. The thermal hydraulics of a number of fuel element designs were predicted by a combination of theoretical analysis and experimental work, both on prototype elements and enlarged models. The topics examined include the pressure drop along the fuel element bundle, the flow distribution across the bundle and the fluid mixing between channels, leading to an assessment of mixed mean outlet temperature and hot-spot temperature for the bundle. The bowing of pins due to thermal gradients, the vibration of pins due to hydraulic forces and the effect on the pin support structure of the swelling or growth of pins during irradiation were examined. The way in which small-sized fuel subassemblies for irradiation in the DFR have been designed to give information relevant to the behavior of the larger subassemblies in the PFR is also discussed, and out-of-pile endorsement experiments which have been carried out on prototype subassemblies for PFR are described. (8 figures) (auth)

17733 EXPERIMENTAL INVESTIGATIONS OF THE THERMODYNAMIC BEHAVIOR OF FAST BREEDER REACTOR FUEL ELEMENTS WITH DIFFERENT SPACER TYPES. Hoffmann, H.; Baumgaertner, E. (Gesellschaft fur Kernforschung mbH, Karlsruhe, Germany). pp 351-368 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

The effect of the mixing rate on the thermodynamic design of fuel elements is demonstrated for bundles with different grid and helical type spacers. In the case of helical type spacers the directional flow close to the box wall was taken into account. Both the mixing rates and the directional flow phenomena were determined experimentally in a turbulent sodium flow with a full-scale 61-rod bundle of SNR dimensions using the "heating method". In specific experiments performed under radial power gradients, results were obtained in support of the theoretical computational program. (13 figures) (auth)

17734 FUEL ASSEMBLY TESTS IN THE Na3 SODIUM LOOP AT CEN/SCK-MOL. Michel, A. (Belgonuleaire, Brussels); Bonaventure, R.; Chatel, R.; Soenen, M. pp 369-387 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French)

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.

The Na3 sodium loop was designed and built as a large fuel assembly testing facility to support the design and fabrication work within the SNR and fast breeder program. The loop characteristics are described. The loop, which has operated since July 1970 a total of 11,500 hours, 7500 hours of which were between 600 and 700°C with a few hours test at 750°C, at present permits automatic cycling of flow and temperature and very high temperature test (up to 750°C). Two test sections are in operation, one for core assemblies and one for blanket assemblies. Tests so far performed include: (a) A first group of tests on two assemblies (core and blanket): hydraulic flow—pressure drop characteristics (measurement at different temperatures); measurement of hydraulic lifting effect and foot leakage during tests at flow above nominal; test at temperature above nominal (650°C). (b) A second group of tests on two other assemblies (core and blanket): long-duration endurance testing at nominal conditions (2000 + 4000 hours), i.e. 600°C and 22.7 kg/s in core subassembly, 6.3 kg/s in blanket subassembly. The test sections are instrumented thermocouples, separate flowmeter for each section, foot leakage flowmeters, differential and absolute pressure sensors, level indicators, S/A lifting indicator. The assemblies tested were SNR prototypes including in the 4000-hour test an advanced concept of spacer grids. The shroud and the bundles are extensively measured before and after testing. A new design of test section is now being studied to increase the flexibility of operations; a basket type support will be included to allow faster modification, according to the type of assembly to be tested. The future use of this very versatile endurance test facility is also described. (9 figures) (auth)

17735 QUESTIONS RELATING TO THE EFFICIENCY OF OXIDE FUEL ELEMENTS UNDER THE CONDITIONS PREVAILING IN A SODIUM-COOLED FAST REACTOR. Golovnin, I. S.; Bibilashvili, Yu. K.; Men'shikova, T. S.; Kalashnik, G. V.; Medvedev, A. V.; Ivanov, Yu. A. (All-Union Scientific-Research Inst. of Problems in Materials, Moscow). pp 389-406 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In Russian).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

Conclusions are drawn from the results of experimental and theoretical studies of the efficiency of oxide fuel elements under the conditions prevailing in a sodium-cooled fast reactor. Computational models and criteria for the reliable functioning of fuel elements, which have subsequently become the basis for designing and fabricating fast reactor fuel elements in the Soviet Union, are selected after a quantitative and qualitative study of the phenomena occurring in fuel elements at high burnups. Consideration is made of how fuel element efficiency is affected by phenomena such as the swelling of steel, the interaction of fission fragments with fuel and cladding, a decline in the strength characteristics of the cladding material and the fuel, and design and technological features. A description is given of the fuel element design developed for the BN-600 reactor and, with this fuel element type as an example, the method of estimating the service life of the cladding is explained. The results of fuel element efficiency calculations are presented; in these calculations, experimental data on the properties of uranium dioxide and OCr16Ni15Mo3B steel are used. (15 figures) (auth)

17736 DESIGN OF GASEOUS WASTE TREATMENT FOR A 140 MW FAST REACTOR. Amadesi, P.; Cazzoli, S.; Cucchi, G. (CNEN, Bologna, Italy). pp 543-566 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The problem being considered is the release to the atmosphere of gaseous fission products formed during operation of the 140 MW PEC fast reactor presently under construction in Italy. Only the sections of three test channels expected to be vented are considered. The production of fission gas has been evaluated, particularly that of ^{133}Xe, ^{85}Kr, ^{131}I and ^{137}Cs, since they are the most significant products in this reactor. By passing the gas mixture through heat exchangers, a change of state in ^{131}I and ^{137}Cs is achieved, thus removing them from the mixture. For the room where the gaseous mixture is stocked the venting capacity necessary for the elimination of the produced radioisotopes is calculated to be a time shorter than the period of the reactor. In calculating this capacity, consideration has been given to a maximum value of 100 Ci/h dischargeable at the stack as a design value, taking into account the most serious meteorologic conditions and stack height. (auth)

17737 MATERIALS FOR FUEL ELEMENT CANS FOR FAST BREEDER REACTORS. Solano, R. R. (Junta de Energia Nucleare, Madrid). Energ. Nucl. (Madrid); 19: No. 87, 21-27 (1974). (In Spanish)

The differences between thermal reactors and fast reactors are tabulated from the viewpoint of selection of the canning materials. The distinct selection criteria to be followed in the case of fast breeders are justified. Corrosion by Na, fragility induced by irradiation, and swelling under irradiation are treated individually to indicate the importance of the selection of the right canning materials. (tr-auth)

17738 ANALYSIS OF SOME ASPECTS FOR FAST SODIUM COOLED REACTOR STEAM GENERATOR DEVELOPMENT. Dubsek, F. (First Brno Engineering Works). Jad. Energ.; 20: No. 5, 154-160(May 1974). (In Czech).

Main aspects and criterions for the projection, construction and exploitation of the sectional module steam generators heated by sodium are mentioned. Some influences on the heat exchange surface of the steam generator are discussed from the point of view of the exploitation, crash situations and corrosion problems. Main principles of the construction and exploitation of the steam generator heated by sodium are shown in the conclusion. 8 references. (auth)

17739 SOME PROBLEMS OF SODIUM TREATMENT IN FAST BREEDER REACTORS. Furukawa, K. (Japan Atomic

Energy Research Inst., Tokai). Genshiryoku Kogyo; 19: No. 6, 22-25(Jun 1973). (In Japanese).

The characteristics of liquid sodium, utilized as a coolant for nuclear reactors, are not well understood. Liquid sodium is considered to be a complex system bound by nonlocalized electrons, and a theoretical treatment of it has not yet been made. The solubility of various impurities in liquid sodium is very low, for example the solubility of oxygen in liquid sodium is 0.014 atom %, therefore analysis of the solubility in liquid sodium is very difficult. The liquid state of sodium is strongly dependent upon temperature, for example saturated solubility of carbon at 600°C is 10^5 to 10^6 times as large as that at the fusing point. Liquid sodium has chemically active characteristics, and can be easily contaminated, so that contamination with substances containing oxygen, water, hydrogen, carbon and halogen can hardly be prevented. The structural material for sodium containing equipment is stainless steel, which complicates sodium behavior, for stainless steel is an alloy of about five components, Fe, Cr, Ni, C, and others. The solubility in liquid sodium is so low that the equipment can not be of fine structure, but must be of large-sized structure to avoid clogging due to precipitation and suspension. Liquid sodium is chemically dangerous and injurious to health, so complete protection from exposure to it must be maintained. However difficult treatment of liquid sodium is, it is believed that it is the most suitable liquid metal for reactor coolant application. (JA)

17740 RESEARCH AND DEVELOPMENT OF A SMALL EDDY-CURRENT PROBE-TYPE FLOWMETER FOR FUEL FAILURE DETECTION AND LOCATION SYSTEM FOR LMFBR. Ogushi, K.; Hayakawa, S.; Hanamiya, I. (Fuji Electric Co., Ltd., Tokyo). Fuji Jiho; 46: No. 6, 541-546(Jun 1973). (In Japanese).

The development of an in-core probe-type eddy-current flowmeter for the prototype fast breeder reactor Monju is described. The flowmeter consists of multiple primary coils and differential type secondary coils. Eddy-currents are generated by the interaction between sodium flow velocity and the magnetic flux density produced by the primary coils. The differential output of the two voltages which are induced in the secondary coils by the eddy-current is proportional to the sodium flow velocity. Flowmeters with outer spool diameters of 7.6ϕ, 10.2ϕ, 10.5ϕ, 13.5ϕ and 14ϕ cm were constructed. Using a sodium test loop, the characteristic test and the mock-up test of the eddy-current type flowmeter were performed. As a result of the characteristic test, it was found that the sensitivity and linearity of the flowmeter were excellent. The optimum exciting frequency was determined. Since the output signal was affected so strongly by the void in sodium flow, the flowmeter might have application as a void detector. No interference among adjacent flowmeters was observed. (JA)

17741 PROMISE OF FAST BREEDER REACTORS. Iyengar, P. K. (Bhabha Atomic Research Centre, Trombay, India). Nucl. India; Republic Day Special: 14-17(26 Jan 1974).

A discussion of the advantages and disadvantages of LMFBRs is presented. The $^{232}Th-^{233}U$ cycle is emphasized in view of India's vast thorium reserves. (DG)

17742 DEVELOPMENT WORK ON FAST REACTORS IN THE USSR. Kazachkovskii, O. D. At. Energ. (USSR); 36: No. 6, 444-449(Jun 1974). (In Russian).

A brief summary of development work on fast reactors since their inception in 1949 is presented. It is concluded that the necessary scientific prerequisites and engineering know-how to create economical nuclear power stations based on fast reactors exist. (auth)

17743 CORROSION RESISTANCE OF STRUCTURAL MATERIALS IN N_2O_4 AND COOLANT TECHNOLOGY. Sukhotin, A. M.; Lantratova, N. Ya.; Trubnikov, V. P.; Atroshenko, E. I. At. Energ. (USSR); 36: No. 6, 496-501(Jun 1974). (In Russian).

The dependence of the corrosion resistance of stainless steels in equilibrium nitrogen oxides: $N_2O_4 \rightleftharpoons 2NO_2 \rightleftharpoons 2NO + O_2$ on time, temperature, pressure and flow rate is presented. Certain questions of coolant technology are considered as well. (auth)

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Refer also to abstracts 15868, 16536, 17654, 17684, 17826, 17829, 17831, 17837, 17838, 17848, 17854, 17858, 17860, 17872, 17921, 17965, 17966, and 17969.

17744 (AREAEE-174) FAST NEUTRON FLUX DISTRIBUTION IN THE EGYPTIAN-REACTOR CORE CAVITY, THEORETICAL AND EXPERIMENTAL. El-Mofty, O. H.; Salama, F. E.; Goher, Y. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 21p. Dep. NTIS (US Sales Only) $4.25.

Theoretical and experimental studies of the fast and thermal neutron flux distributions in a rectangular water cavity were made in the AR E-RR-1 reactor core. A sulfur threshold detector was used. Measurements were made along chosen directions approximating slab geometry conditions. The two-group diffusion equation in one dimension was applied for an ideal multizone core using a new computational method. Four zone were recognized; sub-core I, a water cavity, sub-core II and a water reflector on the two sides. The data are presented in tables of absolute and relative units as well as comparative curves. The theoretical and experimental results show good agreement with a depression of fast flux of 26%. The minimum was shown not to coincide with the center of the cavity but shifted away from the core center. Slight discrepancy between experiment and theory was observed, but it is explained by the depletion of core in the central zone as well as by the effect of control rods. (auth)

17745 (CONF-721018-(Vol. 3), pp 1131-1147) THREE-DIMENSIONAL ANALYSIS OF THE FTR SHIELD MOCK-UP EXPERIMENT. Boulette, E. T.; Bunch, W. L.; Marr, D. R. (Hanford Engineering Development Lab., Richland, WA). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Diffusion theory analyses of the Fast Test Reactor (FTR) Engineering Mock-Up Critical experiments demonstrate that diffusion theory is adequate for calculating the neutron flux distribution in a fast reactor environment. The analyses also indicate that no significant neutron streaming can be associated with the FTR below-core shield. In addition to these results, the overall FTR shielding experimental program is discussed. (26 references) (auth)

17746 (EUR-5120-d) NEUTRON SOURCE WITH HIGH STRENGTH AND WELL DEFINED SPECTRUM. Nicks, R. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 203p. (In German). Dep. NTIS (U. S. Sales Only) $13.25. BF 275.-.

Thesis. Submitted to Technische Univ. Hannover, Ger.

In shielding studies, one investigates radiation attenuation properties of various media such as water, concrete, iron, etc. These studies require intense neutron sources with a simple geometry and a well defined spectrum. The design and construction of a neutron converter are described. The neutron converter EURACOS consists of a uranium disk accomodated in front of the thermal column of the heavy water reactor Ispra I. The incident thermal neutron flux induces fission reactions inside the disk. In comparison with other existing facilities, the EURACOS source intensity (10^{14} n/sec) is 500-1000 times stronger. Special care has been taken in order to achieve a pure fission spectrum of the neutrons emitted. One other advantage of the facility consists in the possibility of executing "dry" irradiations. The irradiation facility has now been operating satisfactorily for several years. Various experiments achieved on this facility are described. (auth)

17747 (JEN-279) ANNUAL REPORT ON JEN-1 AND JEN-2 REACTORS. Montes Ponce de Leon, J. (Junta de Energia Nuclear, Madrid (Spain). Div. de Fisica). 1974. 41p. (In Spanish). Dep. NTIS (US Sales Only) $5.25.

Routine operation and maintenance are described together with details of repairs due to failures which caused scrams. Radiation monitoring data are also presented. (auth)

17748 (ZJE-143) USING HARMONICAL ANALYSIS FOR EXPERIMENTAL VERIFICATION OF REACTOR DYNAMICS. Hrstka, V. (Skoda, Plzen (Czechoslovakia)). 1974. 88p. Dep. NTIS (US Sales Only) $7.50.

The method of identification in the frequency band is discussed, and the application of the method of static programming to digital harmonic and polynomial analysis is described. The theoretical part treats the questions associated with the accuracy of the method of static programming when applied to digital harmonic analysis. The treatment is performed from the viewpoint of the variation of the mean value of the analyzed signals, and from the viewpoint of using symmetrical trapezoidal periodic signals. The experimental part deals with the evaluation of the suitability of this method in determining the frequency characteristics of the SR-0A reactor. The results derived have been used in planning the start-up experiments of the KS-150 reactor in the A-1 nuclear power station. (auth)

17749 NEUTRON DIAGNOSTICS. Harms, A. A.; Robinson, J. E. (McMaster Univ., Hamilton, Ontario). Trans. Amer. Nucl. Soc.; 18: 30-31(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17750 SIGNIFICANCE OF EBR-II HIGH-FLUENCE SWELLING RESULTS. Bump, T. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 106 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17751 ATR-ETR RATES OF OXIDE FILM FORMATION ON ALUMINUM FUEL PLATES. Hanson, G. H.; Bush, W. J.; Griebenow, M. L.; Fillmore, G. N.; Nielsen, H. H. (Aerojet Nuclear Co., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 18: 127 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17752 CORRELATION OF ANALYTICAL AND EXPERIMENTAL DEFORMATIONS OF AN EBR-II SUBASSEMBLY HEXCAN RESULTING FROM A HYPOTHETICAL FUEL PIN FAILURE. Ash, J. E.; Marciniak, T. J. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 196-197 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17753 HEXCAN RESPONSE TO TRANSIENT INTERNAL PRESSURES: A THREE-DIMENSIONAL SOLUTION. Marchertas, A. H. (Argonne National Lab., IL); Belytschko, T. Trans. Amer. Nucl. Soc.; 18: 197-198 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17754 IN-PILE FAILURE THRESHOLD EXPERIMENT (H5) WITH PRE-IRRADIATED FFTF-TYPE FUEL. Wright, A. E. (Argonne National Lab., IL); Rothman, A. B.; Dickerman, C. E.; Stahl, D.; De Volpi, A.; Harrison, L. J.; Hughes, T. H.; Agrawal, A. K. Trans. Amer. Nucl. Soc.; 18: 211-212 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17755 FAILURE EXPERIMENT ON HIGH-POWER FFTF-TYPE FUEL IN A TRANSIENT OVERPOWER ACCIDENT (TEST E7). Doerner, R. C.; De Volpi, A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 212 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17756 EVALUATION OF THE FEFP LOOP CONTAINMENT MARGIN FOR FUEL COOLANT INTERACTION. Wang, P. Y.; Bezella, W. A.; Ahmed, H. U. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 263-264 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17757 TRANSPORT CALCULATIONS FOR REACTIVITY MEASUREMENTS IN SUBCRITICAL CONFIGURATIONS OF THE FFTF ENGINEERING MOCKUP CORE. Flanagan, G. F.; Simpson, D. B.; Selby, D. L.; Mihalczo, J. T. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 268 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17758 FOUR-INCH-DIAMETER GLORY HOLE CRITICAL EXPERIMENT. Kazi, A. H.; Dubyoski, H. G.; Harrison, R. C.; Watson, J. L. (Ballistic Research Labs., Aberdeen Proving Ground, MD). Trans. Amer. Nucl. Soc.; 18: 301-302 (Jun 1974).
From annual meeting of the American Nuclear Society, Philadelphia, PA (23 Jun 1974).

17759 POWER REACTOR SHUTDOWN REACTIVITY METER BASED ON A NOVEL REACTOR NOISE ANALYSIS TECHNIQUE. Behringer, K.; Jeschki, W.; Leoni, B.; Phildius, J.; Pruys, H. S.; Seifritz, W. (Swiss Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). Trans. Amer. Nucl. Soc.; 18: 302-303 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17760 TECHNIQUE FOR PREDICTING FRICTIONAL CONDITION OF EBR-II PRIMARY PUMPS. Mohr, D. (Argonne National Lab., IL); Price, C. C.; Gale, N. L. Trans. Amer. Nucl. Soc.; 18: 305-307 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17761 ANALYSIS OF PLATE-ROD HETEROGENEITY MEASUREMENTS IN DEMONSTRATION REACTOR BENCHMARK ASSEMBLIES INCLUDING THE EFFECT OF STREAMING. Zolotar, B. A. (Argonne National Lab., IL); Grasesechi, G.; Kier, P. H. Trans. Amer. Nucl. Soc.; 18: 309-310 (Jun 1974).
From Annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17762 FINE STRUCTURE EFFECTS IN CENTRAL WORTH CALCULATIONS. Kier, P. H.; Zolotar, B. A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 310 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17763 INFLUENCE OF CONTROL RODS AND SODIUM-FILLED CONTROL CHANNELS ON THE ^{238}U DOPPLER EFFECT. Kaiser, R. E.; Gasidlo, J. M.; Goin, R. W. (Argonne National Lab., Idaho Falls, ID). Trans. Amer. Nucl. Soc.; 18: 310-311 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelpha, PA (23 Jun 1974).

17764 ESTIMATION OF ANISOTROPIC EFFECT OF DIFFUSION COEFFICIENT IN A FAST CRITICAL ASSEMBLY. Takeda, T.; Kurihara, K.; Yamamoto, M. (Hitachi Ltd., Kanagawa, Japan). Trans. Amer. Nucl. Soc.; 18: 320-321 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17765 REACTIVITY SURVEILLANCE PROCEDURES DEVELOPMENT PROGRAM FOR THE FFTF. Upton, J. W. Jr. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 343-344 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17766 SOURCE MULTIPLICATION MEASUREMENTS WITH A MOCKUP OF THE FAST TEST REACTOR. Mihalczo, J. T.; Mathis, M. V.; Pare, V. K. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 344-345 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17767 IKRD MEASUREMENTS FOR SUBCRITICAL CONFIGURATIONS OF THE FFTF ENGINEERING MOCKUP CORE. Mihalczo, J. T. (Oak Ridge National Lab., TN); Mathis, M. V.; Pare, V. K.; Allen, J. W. Trans. Amer. Nucl. Soc.; 18: 345-346 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17768 BREAKFREQUENCY NOISE ANALYSIS MEASUREMENTS FOR SUBCRITICAL CONFIGURATIONS OF THE FFTF ENGINEERING MOCKUP CORE. Mihalczo, J. T. (Oak Ridge National Lab., TN); Pare, V. K.; Mathis, M. V.; Shahrokhi, F. Trans. Amer. Nucl. Soc.; 18: 346-347 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17769 ENERGY- AND REGION-DEPENDENT BUCKLINGS FOR THE FFTF ENGINEERING MOCKUP CORE FROM MONTE CARLO. Petrie, L. M.; Cross, N. F. (Union Carbide Corp., Oak Ridge, TN). Trans. Amer. Nucl. Soc.; 18: 348-349 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17770 MODIFIED SOURCE MULTIPLICATION MEASUREMENTS IN FTR USING FEW-GROUP DIFFUSION THEORY. Fleischman, R. M. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 349-350 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17771 USE OF A FAST PULSE REACTOR AS A GAMMA SOURCE. Dunn, T. A.; Harrison, R. C.; Kazi, A. H. (Ballistic Research Labs., Aberdeen Proving Ground, MD). Trans. Amer. Nucl. Soc.; 18: 369 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17772 FTR SODIUM-COOLANT ACTIVITY. Kidman, R. B. (Westinghouse Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 372-373 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17773 CALCULATIONAL ANALYSIS OF EBR-II GRID PLATE DOSIMETRY TESTS. Franklin, F. C. (Argonne National Lab., IL); Meneghetti, D.; Ebersole, E. R. Trans. Amer. Nucl. Soc.; 18: 373-374 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17774 ANALYSIS OF ZPPR/FTR-2 TLD MEASUREMENTS USING ENDF/B-III DATA. Muir, D. W.; LaBauve, R. J. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 395-396 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17775 DESIGN AND PREPARATION OF THE MOL-7B IRRADIATION EXPERIMENT. Van Miegroet, J. (Belgonucleaire, Brussels); Dewandeleer, J.; Michel, A.; Kummerer, K.; Van Massenhove, G. pp 163-183 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).

From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.

The MOL-7B irradiation experiment in progress since July 1972 in the Br 2 reactor in Mol (Belgium) is one of the four in-pile tests designed by the DeBenelux Consortium to demonstrate and optimize the pin bundles to be inserted into the Mark I core of the SNR-300 reactor. The MOL-7B experiment, the third in the series, aims primarily at simulating some of the extreme operating conditions of the RAPSODIE-I experiment and thus at assessing more closely the material behavior and failure probability associated with such an operation. The MOL-7B bundle features 18 fuel pins distributing round the central cell of a 19-position triangular lattice. Pin spacing is provided by a series of 8 spacer grids regularly distributed along the bundle length and embedded in a structural rod (tie-rod) located in the central position of the lattice. The grids-tie-rod system is a self-supporting type of structure (bird-cage) secured to the anchor grid and thus to the subassembly foot, at the tie-rod lower end. Hold-down of the individual fuel pins is also provided by the anchor grid. Of the 18 fuel pins, 16 are of the pelletized type: the last two are vibrocompated. The cladding materials are those of the RAPSODIE-I experiment: the solution-treated stainless steels WN 4970 and WN 4988. The subassembly was loaded into the central channel of the BR 2 reactor as part of the in-pile sodium loop—500 kW. The nominal target values are 80,000 MW-d/t UO_2–PuO_2 (peak pellet) for the burnup; 500 W/cm (peak pellet) for the linear power; and 697°C (at core outlet) for the cladding midwall temperature. (9 figures, 4 tables) (auth)

17776 TRACK AUTORADIOGRAPHY OF AIR SAMPLES FROM ENVIRONMENTAL AIR CONTAMINATED WITH ^{239}Pu. Kruger, J.; Constantine, J; van Niekerk, R. (Atomic Energy Board, Pelindaba, South Africa). pp 482-496 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

As a result of the failure of the start-up source during commissioning of the SAFARI-1 research reactor, the reactor system was contaminated with ^{239}Pu. Although the contamination was systematically reduced over the years, it was often found necessary for maintenance operations to be carried out in air contaminated up to levels of 10^{-3} $\mu Ci/cm^3$. A large number of air samples was taken on glass fiber filter paper and membrane filters during such operations and autoradiographed by means of exposure to nuclear emulsion and microscopic examination. Results are given of the activity attachment to observed particulate material, and compared with the results obtained during simultaneous sampling with a cascade centripeter. A fair agreement is illustrated. The consequences of these results in terms of the airborne hazard of the plutonium contamination are discussed. (auth)

17777 PREVENTIVE RADIATION PROTECTION: EXPERIENCE ACQUIRED AT THE IRR-2. Baram, Y. (Nuclear Research Centre-Negev, Beersheba, Israel). pp 497-502 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

Conventional methods of radiation protection try to minimize risks to the staff and surroundings. In spite of all precautions, incidents do happen, causing exposure of workers and contamination of persons and/or areas. An incident on an active loop begins generally by a change in the radiation level near the loop. This change, even if small, indicates abnormal functioning of that loop and is detected by the very sensitive radiation protection instruments, spread over the rooms and corridors. These instruments, installed primarily as personal survey monitors, are sensitive to even very small changes in radiation levels, and thus perceive a malfunctioning at its very beginning. A number of incidents, reported here, could be detected at an early stage by the radiation protection instruments at the IRR-2: heavy water leaks, helium leaks, inopportune presence of air in the helium circuit, loss of air cooling at experimental facilities, corrosion in the demineralized water circuit, and abnormal neutron flux at an epuration pot. From the experience gained during recent years at the IRR-2, the use of the threshold alarm is recommended at a level far below the danger level for the workers. It should indicate any deviation, however small, from the normal level. Such a deviation should then be considered by the chief operator as a possible beginning of malfunctioning. The radiation detectors should be placed so as to permit the continuous survey of the active loops. This would result in a more effective prevention of incidents. (auth)

17778 OPTIMUM MIXED CONDITION FOR POLYETHYLENE–URANIUM HOMOGENEOUS REACTOR. Tsai, J.; Chen, R. C. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 9: No. 1-2, 1-11(Jun 1972).

The effects of variations in geometry and density on the critical mass of a polyethylene-uranium homogeneous reactor are investigated by the modified two-group method. Results show that the critical mass is of the least amount in the case of the graphite reflected spherical core among our three calculated cases, and the absolute slopes of the critical mass with respect to enrichment will increase when the density of the fuel plate is increased in the range between 25 to 30 w/o enrichment, but that will be vice versa in the range between 15 to 20 w/o enrichment. (auth)

17779 NUCLEAR CHARACTERISTICS OF THOR 2ND CORE. Tsai, J.; Yuan, L. J.; Chen, R. C.; Dunn, S. P.; Lin, C. F. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 8: No. 3-4, 11-16(Dec 1971).

Nuclear characteristics are analyzed of THOR 2nd core by the calculation processes on two-group diffusion theory. The reactor was separated into three regions; core, graphite reflector and water reflector. After applying suitable boundary conditions, the critical volume, critical mass and flux distributions were all obtained. For finding out with certainty the critical mass was measured by experiment. Quite satisfactory result was earned by comparison. 5 references. (auth)

17780 HAZARD ANALYSIS OF MODIFIED KINKI UNIVERSITY REACTOR. Miki, R.; Kawai, H.; Honda, Y.; Nakamura, K. (Kinki Univ., Osaka). Kinki Daigaku Genshiryoku Kenkyusho Nenpo; 10: 33-39(In Japanese).

On October 12, 1973, the modifications of Kinki University Reactor, UTR, were permitted by the Japanese Government. The modifications include (1) increase of thermal power, from 0.1W to 1W, (2) change of maximum excess reactivity, from 0.25% $\delta k/k$ to 0.5% $\delta k/k$, and (3) installation of the same experimental facilities. Hazard analysis of the maximum credible accident of the modified Kinki University Reactor is presented. (auth)

17781 NUCLEAR DESIGN OF LOCAL HIGH FLUX ZONE IN THOR CORE. Tsai, J. (National Tsing Hua Univ., Hsinchu, Taiwan); Yuan, L. J.; Yu, B.; Yu, P.; Chen, R. C. Nucl. Sci. J. (Taiwan); 8: No. 2, 1-10(Jun 1971).

The preliminary nuclear design of a local high flux zone in the THOR core is discussed. A special region which contains the weak absorbing materials such as water, graphite or beryllium is set up. This test zone can be used in radiation or shielding experiments. The design is based on two-group theory. Results indicate that when conventional core material in the test zone is replaced by water, the thermal flux is doubled without any increase in power density. The increment of critical mass is 322.7 grams of ^{235}U. (auth)

17782 SORA PROJECT AT ISPRA. Haas, R.; Misenta, R. (Commission of the European Communities, Ispra, Italy). Euro-Spectra; 12: No. 4, 90-106(Dec 1973).

A description of the SORA pulsed reactor neutron source is given. Included are characteristics of construction, operation, and instrumentation. The experimental facilities and neutron flux characteristics are also described. (DG)

17783 HELIUM-GAS PURIFICATION TESTS FOR OGL-1. Fukuhara, M. (Kawasaki Heavy Industries, Ltd., Kobe, Japan); Izaki, T.; Tone, H.; Kondo, K. FAPIG (Tokyo); No. 69, 2-7 (May 1973). (In Japanese).

The Oarai Gas Loop No. 1 (OGL-1) is to be installed in the Japan Material Testing Reactor of JAERI for studies of nuclear fuel and other materials for high-temperature gas cooled reactors in a helium flow environment. The testing apparatus for obtaining design data for gas purification for the OGL-1 and the tests performed with it are described. Among the studies made were dynamic adsorption behavior of adsorbents toward impurity gases, regeneration of traps, lifetime of titanium sponge traps, and helium gas supply. The testing apparatus consisted of a main circulation system, a test section with molecular sieve, titanium sponge and charcoal traps, impurity gas supply and exhaust systems and a regeneration system. (JA)

17784 CERTAIN CONCLUSIONS DRAWN FROM OPERATIONAL EXPERIENCE AT THE WORLD'S FIRST ATOMIC POWER STATION. Blokhintsev, D. I.; Dollezhal, N. A.; Krasin, A. K. At. Energ. (USSR); 36: No. 6, 423-426(Jun 1974). (In Russian).

Twenty years of operation of the APS reactor at Obninsk and its effect on the growth of nuclear power are analyzed. The basic engineering and economic data obtained at this atomic power station and realized at succeeding reactors of the same type are discussed. (auth)

17785 DESIGN AND CONSTRUCTION OF THE THERMIONIC NUCLEAR POWER PLANT TOPAZ. Kuznetsov, V. A.; Gryaznov, G. M.; Artyukhov, G. Ya. At. Energ. (USSR); 36: No. 6, 450-457 (Jun 1974). (In Russian).

Basic investigations performed in designing the thermionic nuclear power plant Topaz with its electricity-generating channels, neutron and physical investigations, and design features of the reactor-converter are summarized. Results of power tests on a special test facility using three models of this installation are presented. The main characteristics of the installations during testing are presented. The procedure used to determine the cathode electronic cooling coefficient, measure the dynamic temperature coefficient of reactivity, and investigate the system response to small perturbations of input parameters are described. The future of thermionic reactor-converters as independent energy sources of prolonged operating life is evaluated. The achieved electric power level of 5 to 7 kW is not a limiting one and can be considerably increased by using the latest emitter materials and other means of improving thermionic characteristics. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 17633 and 17807.

Propulsion and Package Reactors

Refer also to abstracts 16255, 16299, 17504, 17815, and 17968.

17786 (CONF-721018-(Vol.1), pp 166-185) MONTE CARLO DEVELOPMENT AND APPLICATIONS IN THE LOS ALAMOS NUCLEAR ROCKET PROGRAM. Watson, C. W.; Cashwell, E. D. (Los Alamos Scientific Lab., NM). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The history of Monte Carlo use in the Rover Nuclear rocket program at LASL is traced. The type of problems requiring Monte Carlo solutions and specific applications are discussed, the latter to show how need led to development and to illustrate capabilities. A synopsis of present codes, code characteristics, and available tally options is included. Of principal interest have been radiation environmental calculations for the Rover reactor-testing program. Recent emphasis, however, has been upon Monte Carlo criticality calculations. Data from experimental studies conducted explicitly to assess Monte Carlo results are presented and discussed. Monte Carlo criticality results are also compared with experiment. Finally, plans for the extension of Monte Carlo capabilities are outlined. 45 references. (auth)

17787 (CONF-721018-(Vol.1), pp 186-197) SHIELDING CHARACTERISTICS OF A NUCLEAR POWERED MANNED SPACE STATION. Keshishian, V. (Atomics International, Canoga Park, CA). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The use of nuclear power for manned space stations is very attractive for missions of long duration. For space stations requiring a large shield cone half angle, the shield weight may be minimized by placing the radioactive primary loop equipment around the reactor radial shield. The selection of shield materials was based on a minimum weight shield, and on engineering and safety constraints. In arriving at the final shield design, various operational constraints, such as rendezvous dose and flyby dose, were considered. For the thermoelectric and Brayton systems, the reactor thermal power was 680 and 127 kw(t) respectively, and the corresponding shield weights were 13,000 and 8,900 lb. (auth)

17788 (CONF-721018-(Vol.1), pp 198-214) SHIELDING PROBLEMS IN FUSION REACTORS. Blow, S. (Atomic Energy Research Establishment, Harwell, Eng.); McCracken, G. M. 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The radiation shielding problems which have been identified at the current stage of fusion reactor development are described. The topic selected from this problem list for major discussion is the need to protect the superconducting magnet from radiation penetrating through the main shield. The effects which require to be assessed are (a) the nuclear heating occurring in the cryogenic magnet region, and (b) the displacement damage caused by the neutron flux. It is shown that at power levels required for economic operation the damage effect (b) is the more serious. 15 references. (auth)

17789 (CONF-721018-(Vol.2), pp 396-408) DEVELOPMENT OF CALCULATION METHODS AND CODES AND THEIR APPLICATION TO SPACE REACTOR SHIELDING. Amin, E.; Hehn, G.; Klumpp, W.; Ruehle, R. (Univ., Stuttgart). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

For simplifying the handling of different reactor and shielding programs with large data input and output the modular program system RSYST has been developed which works with a central data pool from which the individual module gets all data and writes the results back. For two-dimensional deep penetration problems a special S_N-procedure is recommended which overcomes the ray effect by applying first collision correction together with local separation technique. An optimization method using dynamic programming was developed for space reactor shielding. 4 references. (auth)

17790 (N-71-38251) MECHANICAL EVALUATION OF TAA 5/4 AFTER 10,823 HOURS OF OPERATION IN PCS-1. Cherry, M. G. (Aerojet-General Corp., Azusa, Calif. (USA)). 15 Oct 1970. Contract NAS3-13458. 116p. (NASA-CR-72921; AGC-TM-7977 :70-617). NTIS.

The SNAP-8 Turbine Alternator Assembly was operated 10,823 hours between 4 July 1967 and 22 September 1969. The unit was disassembled, inspected, and reassembled only once at 2122 hours of operation. Erosion was distinctly evident on the second and third stage rotor blade leading edges, barely discernible erosion was indicated on the other stages. Some mass transfer buildup was observed in the third stage nozzle. The rotating assemblies of turbine and alternator were in very good condition. The bearings in both assemblies were in excellent condition showing only slight blemishes. Minute cracks previously observed in the first stage nozzle assembly had propagated. The mechanical integrity of the part was not endangered. Continued cavitation damage on the visco ring was also observed. None of the damage sustained was considered to preclude reassembly and continued operation for an additional 10,000 hours. (auth)

17791 (N-74-10677) SIMULATOR TEST TO STUDY HOT-FLOW PROBLEMS RELATED TO A GAS COOLED REACTOR. Poole, J. W.; Freeman, M. P.; Doak, K. W.; Thorpe, M. L. (Humphreys Corp., Concord, N. H. (USA)). Oct 1973. 115p. (NASA-CR-2309). NTIS $4.25.

An advance study of materials, fuel injection, and hot flow problems related to the gas core nuclear rocket is reported. The first task was to test a previously constructed induction heated plasma GCNR simulator above 300 kW. A number of tests are reported operating in the range of 300 kW at 10,000 cps. A second simulator was designed but not constructed for cold-hot visualization studies using louvered walls. A third task was an investigation of practical uranium feed systems, including a detailed discussion of related problems. Two designs for plasma nozzle test devices that could be operated at 200 atm on hydrogen are presented. (auth)

17792 (N-74-10842) VIBRATION BEHAVIOR OF FUEL-ELEMENT VIBRATION SUPPRESSORS FOR THE ADVANCED POWER REACTOR. Adams, D. W.; Fiero, I. B. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Nov 1973. 31p. (NASA-TM-X-2920; E-6816). NTIS $3.00.

Preliminary shock and vibration tests were performed on vibration suppressors for the advanced power reactor for space application. These suppressors position the fuel pellets in a pin type fuel element. The test determined the effect of varying axial clearance on the behavior of the suppressors when subjected to shock and vibratory loading. The full-size suppressor was tested in a mockup model of fuel and clad which required scaling of test conditions. The test data were correlated with theoretical predictions for suppressor failure. Good agreement was obtained. The maximum difference with damping neglected was about 30 percent. Neglecting damping would result in a conservative design. (auth)

17793 NUCLEAR SYSTEM SUITABLE FOR AIRCRAFT PROPULSION. Jones, A. R.; Thompson, R. E. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 3-4 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17794 GAMMA-RAY HEATING CALCULATIONS FOR A GAS CORE REACTOR. Lu, P. K. (United Energy and Constructors, Inc., Philadelphia); Bull. S. R. Trans. Amer. Nucl. Soc.; 18: 4-5(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 June 1974).

17795 STANDARDIZED ZIRCONIUM HYDRIDE REACTOR POWER SYSTEM FOR SPACE APPLICATIONS. Mason, D. G.; Van Osdol, J. H. (Atomics International, Canoga Park, CA). Trans. Amer. Nucl. Soc.; 18: 16(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17796 ECONOMICS OF SPACECRAFT STANDARDIZATION. Greenberg, J. S. (Princeton Univ., NJ). Trans. Amer. Nucl. Soc.; 18: 16-17(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17797 SHIP OPTINOMICS. SNAME 1972 Spring Meeting Papers Including Discussions and Closures, Williamsburg, Virginia, May 24-27, 1972. New York; Society of Naval Architects and Marine Engineers (1972). 122p. (CONF-7205110-).

Eight papers as well as the text of a luncheon address on ship optinomics are included. One paper, "Nuclear Maritime-An Economic Revival", has previously been abstracted in NSA. (JWR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 15371, 15374, 15375, 15530, 15532, 15986, 16290, 17780, 17978, 18012, and 18013.

17798 (AEC-tr-7558) TERMINOLOGY AND METHODOLOGY USED IN RELIABILITY ANALYSIS. Carnino, A. (CEA, 75 - Paris (France). Dept. de Surete Nucleaire). Jun 1974. Translation of SETS Report No. 11. 35p. Dep. NTIS $4.75.

A summary of concepts and terms currently used in reliability is presented. A list of definitions of basic terms is followed by a presentation of the various methods of analysis used in reliability. The methods are supplemented by the symbology used in both the U. S. and England. Included are figures illustrating various methods described previously showing the conditions under which, in the opinion of the authors, they are best used for analyzing safety and the progress of reactor accidents. (auth)

17799 (AED-CONF-73-664-1) STATIC ANALYSIS OF THE PRESSURE-SUPPRESSION SYSTEM OF THE KWU-BWR. Haun, U. (Kraftwerk Union A. G., Frankfurt am Main (F. R. Germany)). 1973. 30p. (In German). ZAED.

From finite element congress; Baden-Baden, F. R. Germany (19 Nov 1973).

The originally proposed unreinforced shell of the pressure-suppression system turned out to be not strong enough to carry the blowdown loads safely. A reinforcement of the bottom part of the condensation chamber was necessary. This redesign which turned out to be the best solution consists essentially of two steel shells interconnected by a system of radial ribs. The static analysis using the ASKA code is described, and the modelling for the power plants Brunsbuettel und Phillippsburg and the differences in modelling are emphasized. (INIS)

17800 (AED-CONF-74-2-1) RELIABILITY ANALYSIS AS A TOOL FOR THE OBJECTIVE VALUATION OF TECHNICAL SYSTEMS. Bastl, W. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). 1974. 5p. (In German). INIS.

From 2nd information meeting of the Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching (LRA). Main topic: systems analysis and reliability engineering; Muenchen, F. R. Germany (16 Jan 1974).

The question is discussed of why reliability analysis is not yet widely used in reactor techniques. Two reasons seem to be of special importance: The difficult technical primary conditions and the fundamental difficulties in the valuation of probable results. (INIS)

17801 (AED-CONF-74-2-3) INFORMATION SYSTEM TO OBTAIN RELIABILITY DATA FOR POWER PLANT COMPONENTS. Wohak, B.; Kargl, W. 1974. 4p. (In German). INIS.

From 2nd information meeting of the Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching (LRA). Main topic: systems analysis and reliability engineering; Muenchen, F. R. Germany (16 Jan 1974).

Details of an information system are given which enables data to be obtained on the reliability and safety of power plant units. The performance of the system cannot be judged conclusively at this state, but the system is intended to be used for nuclear power plants as well if it proves successful. (INIS)

17802 (AED-CONF-74-6-1) SIMULATION OF THE SIMULTANEOUS FAILURE OF ALL COOLANT PUMPS IN A SODIUM-COOLED FAST BREEDER REACTOR. Angerer, G.; Fischer, F. A.; Kuczera, B.; Royl, P.; Struwe, D.; Wirtz, P. (Kernforschungszentrum Karlsruhe (F. R. Germany)). 1974. 7p. (In German). INIS.

From experts meeting of the task groups "thermodynamics and fluid dynamics" and "reactor physics" of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactor; Karlsruhe, F. R. Germany (29 Jan 1974).

In order to investigate the extremely complicated phenomena occurring during the mainly nondestructive phase of an incident due to the simultaneous failure of all coolant pumps, the program system CAPRI was developed. The main features of the system are described with emphasis on the following modules which are of importance in the simulation of incidents of this kind: a) BLOW3 — a module for the description of boiling phenomena in sodium-cooled fuel elements; b) BREDA — a module for the analysis of fuel rod elongation under transient load; c) SLB — a module for the description of slumping phenomena. On the basis of the MARK - I core of the SNR 300, the influence of boiling and superheating, of the simulation of the steady-state thermohydraulic design and the slumping parameters on the course of the incident are discussed. (INIS)

17803 (ANL-8062) ANALYSIS OF FFTF PRIMARY-CONTAINMENT COMPLEX-MODEL EXPERIMENTS. Marciniak, T. J.; Gvildys, J.; Nagumo, G.; Ash, J. E. (Argonne National Lab., Ill. (USA)). Jan 1974. Contract W-31-109-Eng-38. 47p. AT.

The 1/30th- and 1/10th-scale complex models of the Fast Test Reactor using the REXCO-HEP code have been analyzed. The purposes of the calculations were to provide some insight into the interpretation of the experimental results as applied to the prototype configuration, and to test some of the modeling techniques used in evaluation of the containment on an actual model. Calculations were made for both models using pressure-volume relationships in the core determined from simple experiments and material properties. Also calculated was a 1/10th-scale configuration using the properties of Type 304 stainless steel and sodium in place of the nickel-200 and water used in the tests. Results show good agreement between the test and analysis for items such as slug-impact time, vessel deformation above the core-support structure, core-barrel maximum strain, vessel-head displacement, and holddown-bolt strains. Replacement of nickel-200 and water with Type 304 stainless steel and sodium gave slightly altered results, which were essentially of the same mode and magnitude. (auth)

17804 (BMI-X-647) MONITORING POSTACCIDENT CONDITIONS IN POWER REACTORS. Denning, R. S.; Miller, N. E.; Plummer, A. M. (Battelle Columbus Labs., Ohio (USA)). 9 Apr 1973. 75p. Dep. NTIS $6.75.

Reactor accident surveillance information needs are discussed, and guidelines for the development of accident monitoring systems are presented. The topics covered include responsibilities and limitations of the operator, plant stabilization, classes of accidents, accident sequence flow diagrams, monitoring system variables, instrumentation, display, and computer utilization. (DG)

17805 (BNWL-B-189) REVIEW OF THE EFFECT OF HOUSING TEMPERATURE ON FLECHT HEAT TRANSFER RESULTS. Sutey, A. M.; Rowe, D. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1972. Contract AT(45-1)-1830. 30p. Dep. NTIS $4.50.

A study was made to determine the effect of the flow housing temperature on the PWR-Full Length Emergency Cooling Heat Transfer (FLECHT) experimental results. Flow patterns obtained from FLECHT movie results were used in conjunction with equilibrium thermodynamic analysis and related FLECHT data to define the mode of heat transfer in the FLECHT experiments. The conclusion of the study is that the initial selected housing wall temperature did not adversely affect the FLECHT experimental results during the initial temperature rise and up to turnaround for all flow rates considered. At low flow rates this conclusion can be extended to longer times approaching quench time. The study shows that the two-phase flow during reflood, up to the time of turnaround, can be described as dispersed flow. This type of flow has a very high void fraction which means that it is basi-

cally steam flow with entrained liquid droplets. In the presence of high surface temperatures (above the Liedenfrost Point), the heat transfer process is steam heat transfer controlled at the surface with subsequent heat transfer to evaporate the liquid drops. With this type of heat transfer, the housing wall was found not to adversely affect the FLECHT experimental results during the important period up to turnaround. (auth)

17806 (CONF-740702-2) COMPUTERIZED FISSION PRODUCT INVENTORY SYSTEM. Gileadi, A. E.; Musalem, A. (Puerto Rico Nuclear Center, Mayaguez). 1974. 19p. Dep. NTIS $4.00.

From Health Physics Society annual meeting; Houston, Texas, USA (7 Jul 1974).

A computer code to generate fission product inventories for a given reactor with a given operating history is described. Quantities generated as functions of operating history and cooling time are: (a) densities of each isotope, (b) activities of each isotope, (c) associated beta and gamma spectra, and (d) after-heat production rates. (DG)

17807 (DP-1355) CONFINEMENT OF AIRBORNE RADIOACTIVITY. Progress Report: July–December 1973. Evans, A. G.; Jones, L. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jun 1974. Contract AT(07-2)-1. 27p. Dep. NTIS $4.00.

Analyses of the potassium and iodine contents of KI_3-impregnated carbons show a positive correlation between the ratio of iodine to potassium (I/K) and the radioiodine penetration measured by the high-temperature desorption test. When the atom ratio of I/K exceeds approximately 0.30, there is a logarithmic increase in iodine penetration with a linear increase in the I/K ratio. The high-temperature desorption test, therefore, provides a valuable standard quality control test for commercial KI_3 carbons. Deterioration of water repellency and tensile strength of high-efficiency particulate air (HEPA) filter media during normal service was found to affect simulated accident performance of filters more significantly than similar deterioration resulting from radiation exposure. However, neither radiation exposure nor measured service degradation of particulate filters would be expected to seriously impair overall performance of the Savannah River confinement system if an adequate number of confinement compartments receive approximately equal loading of activity following a postulated reactor accident. (auth)

17808 (EURFNR-1174) CURRENT STATUS OF KNOWLEDGE OF MOLTEN FUEL/SODIUM THERMAL INTERACTIONS. Caldarola, L. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Feb 1974. 44p. (CONF-740230-1; EUR-4973; KFK-1944). Dep. NTIS (US Sales Only) $5.25.

From meeting of the European Safety Working group; Brussels, Belgium (26 Feb 1974).

Work performed under United States–Euratom Fast Reactor Exchange Program.

The papers which were presented at the second CREST meeting on "Sodium/Fuel Interaction in Fast Reactors" at Ispra in November 1973 are briefly reviewed. Some interesting conclusions are obtained based on the experimental and theoretical results presented at the meeting. Areas requiring further investigations are specified. (auth)

17809 (GEAP-13318) BWR BLOWDOWN HEAT TRANSFER PROGRAM, TASK A2 REPORT, 49-ROD BUNDLE TEST PLAN. Nilsson, K. A. (General Electric Co., San Jose, Calif. (USA)). Jan 1974. Contract AT(04-3)-189. 73p. Dep. NTIS $6.75.

A final plan for the 49-rod bundle blowdown heat transfer testing is presented. Program background is outlined and program objectives are included. The test program will investigate reactor blowdown heat transfer phenomena during various loss-of-coolant accidents, including the hypothetical recirculation line break (design basis accident). Test parameters and ranges are selected. Individual tests are defined and arranged in a test matrix, and the test execution strategy is presented. (auth)

17810 (IKE-2-2-DE) THEORETICAL INVESTIGATION OF THE FUEL CAN DEFORMATION (BALLOONING) AND DEVELOPMENT OF A COMPUTER PROGRAM FOR SIMPLIFIED CALCULATION. Munder, E. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Sep 1973. 73p. (In German). ZAED.

Thesis.

During loss-of-coolant accidents in water-cooled reactors, fuel cans can swell as a consequence of temperature transients, causing a partial blockage of the cooling pipes and consequently hindering the emergency cooling. It is necessary to calculate the fuel can deformation (ballooning) to be able to predict the effectiveness of the emergency cooling. A simple, initial model to calculate these effects, the HRODEF-1 computer program, is presented. After an elucidation of the assumptions and basic conditions, the mathematical model and the computer program are described. Finally, the material data of the fuel cans and their importance are discussed, and possible ways of improvement are pointed out. (GE)

17811 (KFK-1902) RESI-THESAURUS FOR THE REACTOR SAFETY INFORMATION SYSTEM. Eglin, W.; Krings, T.; Schultheiss, G. F. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe (F. R. Germany). Projekt Nukleare Sicherheit). Feb 1974. 328p. (In German). INIS.

3 figures; 10 references; with app. With abstract in German and English.

In the development of the RESI-2 prototype system within the framework of a research project entitled "RESI, Reactor Safety Information System", a first approach towards a structured keyword index has been elaborated in the problem area "Nuclear Licensing Procedure". The keyword index is used as an indexing aid in information processing and as a searching aid in the retrieval of information when operating the prototype system. The computer-aided RESI-2 system developed at the Institute of Reactor Development of Gesellschaft fuer Kernforschung mbH, Karlsruhe, uses the GOLEM program devised by Siemens which automatically compiles an alphabetic thesaurus both for the so-called bound descriptors (aspects) and for free descriptors. Structuring into subordinate terms and generic terms and the introduction of synonym crosslinks requires a special processing step. The keyword index published clearly shows the closely intermeshed and superimposed thesauri in the administrative and technical fields in the area of reactor safety and nuclear licensing procedures. The index had to be produced because there was no other useful thesaurus in this problem area. (GE)

17812 (KFK-1947) HEXAGONAL NETS AND TRUSSES. Computer-Controlled Automation of Mesh Generator and Redundancy Analysis. Zehlein, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Apr 1974. 32p. (In German). Dep. NTIS (US Sales Only) $4.75.

Topological aspects of hexagonal networks representing equivalent trusses for the simulation of rod bundle deformation under transverse loading are presented. Certain types of accidents within a fast breeder reactor may lead to permanent deformations of the fuel rods, to reactivity changes, and to danger for the safety system. Therefore the simulation of the deformation of rod bundles under transverse transient loading is an important part of the dynamic structural analysis for a FBR-Core. A tension-free equivalent truss to model the force diffusion and distribution within the bundle section is proposed. The manner in which some typical characteristics of hexagonal nets may be utilized for setting-up the model automatically is shown. In particular an automatic mesh generator is described. It not only calculates the nodal coordinates but also determines simultaneously and recursively for a chosen number of rows within the net the incidence matrix required for bookkeeping purposes. The selection of the redundant forces (so-called "structural cutting") can be done automatically by the computer. The procedure is derived from a theorem concerning the redundancy of the equivalent hexagonal network. The proof of this theorem is given. (auth)

17813 (KFK-1970) BEHAVIOR OF SODIUM FIRES AND SUITABLE PROTECTING SYSTEMS. Huber, F.; Menzenhauer, P.; Peppler, W.; Till, W. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Apr 1974. 142p. (In German). Dep. NTIS (US Sales Only) $10.25.

The safe control of sodium fires requires detailed information about the burning behavior of sodium. Therefore, in the scope of the SNR safety R and D program, the course of sodium fires of different types has been investigated. The studies were directed to sodium area conflagrations and suitable protection systems to confine such fires. The experiments were performed in a closed hall approximately 8 m long × 8 m wide. The area conflagrations were executed in steel pans 0.18 to 4.5 m^2. To avoid larger area conflagrations the pans were furnished with special covers, so that no active quenching measures were needed. The sodium quantities were between 10 to 200 liter at temperatures between 400 and 820°C. Spray fires and fires at isolated pipes were also studied. The temperatures, reaction rates, and the production of aerosols were measured. Tests with extinguishing powder were executed during some fires. The fires were monitored by series of slides and films. (auth)

17814 (KFK-1974) SIMULATION OF TRANSIENT LMFBR-FUEL PIN BEHAVIOR UNDER CONSIDERATION OF CERTAIN BURNUP PHENOMENA. Kuczera, B. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Reaktorentwicklung). Mar 1974. 117p. (In German). Dep. NTIS (US Sales Only) $9.00.

Thesis. Submitted to Karlsruhe Univ. (TH) (West Germany). Fakultaet fuer Maschinenbau.

A theoretical treatment of the behavior of LMFBR-fuel pins under transient overpower conditions is presented. The main objective was to predict the influence of characteristic burnup phenomena on the short-time behavior of fuel pins. The BREDA-II model, which is based on the equations of linear thermoelastic theory, was used. In particular, the axisymmetric plane strain approximation is applied for the mechanical analysis. The multi-region fuel model permits description of long-time and transient burnup phenomena. The long-time irradiation effects considered were steady state fuel swelling, change in fuel porosity, and production and partial release of fission gases. Of particular importance is the transient fission gas release which leads to a pressure increase in the central void and hence to additional loads in the fuel pin. Transient fuel swelling can be modeled. Irradiation dependent changes of the cladding material properties strongly influence fuel pin performance and are discussed together with the fuel pin failure criteria. A comparison of model calculations with experimental results shows good agreement in transient fuel pin deformation. This largely supports the model concept, which is based on a linearly elastic type behavior of the fuel. In a subsequent study, the fuel pin behavior was extrapolated to conditions which may arise during a hypothetical overpower whole core accident simulated by a 5 $/sec reactivity ramp insertion. Effects of burnup levels on the transient behavior are discussed. (auth)

17815 (N-73-32532) REACTIVITY CHANGE IN A FAST-SPECTRUM SPACE POWER REACTOR DUE TO A 328-METER-PER-SECOND (1075-FT/SEC) IMPACT. Peoples, J. A. Jr.; Puthoff, R. L. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Oct 1973. 21p. (NASA-TM-X-2886; E-7481). NTIS $2.75.

Application of nuclear reactors in space will present operational problems. One such problem is the possibility of an earth impact at velocities in excess of 305 m/sec (1000 ft/sec). The results of an impact against concrete at 328 m/sec (1075 ft/sec) are presented and the deformed core is examined to estimate the range of activity inserted as a result of the impact. The results of this examination are that the deformation of the reactor core within the containment vessel left only an estimated 2.7 percent void in the core and that the reactivity inserted due to this impact deformation could be from 4.0 to 10.25 dollars. (auth)

17816 (OOE-OS-1) SUMMARY OF ABNORMAL OCCURRENCES REPORTED TO THE ATOMIC ENERGY COMMISSION DURING 1973. Thompson, D.; Boyle, E. L.; Grosman, L. H. (USAEC Office of Operations Evaluation, Washington, D. C.). May 1974. 172p. Dep. NTIS $11.75.

Reports of 861 abnormal occurrences that took place at nuclear plants during 1973 and that were reported to the AEC are categorized with respect to cause, significance, method of discovery, status of the reactor at the time of discovery, and component and system involved. Categorization was based on information extracted from incoming licensee reports. The information was stored, sorted, and retrieved by computer. (auth)

17817 (ORNL-NSIC-115) INDEX TO NUCLEAR SAFETY. A Technical Progress Review by Chronology, Permuted Title, and Author. Vol. 11, No. 1 Through Vol. 14, No. 6. Cottrell, W. B.; Klein, A. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7405-eng-26. 55p. Dep. NTIS $5.75.

Articles which have appeared in Nuclear Safety, published by the Nuclear Safety Information Center, are indexed by volume in the chronological order of their appearance in the Journal. Titles and authors are keyed to the main index by means of a seven-digit number. Following the index number are the appropriate article title and author. The dates pertinent to each volume are listed in the Introduction. Abstracts are included for all articles. Indexes based on title keywords and authors are also included. (auth)

17818 (ORO-4348-1) EXPERIMENTAL DETERMINATION OF COUNTERCURRENT TWO-PHASE FLOW OF WATER. Ross, D. F. Jr. (Catholic Univ. of America, Washington, D. C. (USA)). 1974. Contract AT(40-1)-4348. 177p. Dep. NTIS $12.00.

Thesis.

In the analysis of loss-of-coolant accidents of light-water cooled nuclear reactors, conditions exist wherein cold liquid water is injected into an upflowing vapor, with the purpose of penetrating the vapor and restoring coolant to the reactor core. The steam-water interaction can, under some circumstances, cause the injected coolant to be entrained instead of falling downward and accomplishing its mission. Experimental determinations of the steam-water interaction are reported. A 3-inch diameter glass tube, 6 feet long, was used as a test section. Steam was admitted at the bottom inside a 2-inch diameter concentric pipe. Liquid was injected at the top in three different modes, including a spray. Steam flow rates varied from 200–500 lbm/hr, pressure from 17 to 38 psia, and liquid flow rates from 300 to 1500 lb/hr. Void fraction was measured with a gamma densitometer. Drop diameters and velocities were measured from high-speed motion pictures. Entrainment rates were measured by collecting the liquid at the top and bottom of the test section, after separating the vapor. The results showed that entrainment, E, could be correlated with the effective momentum flux $\bar{\rho}V_g^2$, where $\bar{\rho}$ takes into account the moisture level in the flowing core. The drops observed had velocity and diameter distributions in accordance with previous research results. (auth)

17819 (RLO-2227-T-17-2) GENERAL CONSIDERATIONS FOR THE DESIGN OF THE MOORINGS FOR OFFSHORE NUCLEAR POWER GENERATING STATIONS. Nath, J. H. (Oregon State Univ., Corvallis (USA)). Apr 1974. Contract AT(45-1)-2227. 71p. Dep. NTIS $6.75.

The general subjects are reviewed which should be considered and presented to the Atomic Energy Commission by applicants for the construction of the moorings of Offshore Nuclear Power Generating Stations, in order that a proper design review can be accomplished. The pertinent literature is reviewed and evaluated with regard to its applicability to the subject. Suggested methods for determining loads and resistances and minimum requirements for information submittal are presented. 92 references. (auth)

17820 (WASH-1318) TECHNICAL REPORT ON ANALYSIS OF PRESSURE VESSEL STATISTICS FROM FOSSIL-FUELED POWER PLANT SERVICE AND ASSESSMENT OF REACTOR VESSEL RELIABILITY IN NUCLEAR POWER PLANT SERVICE. (USAEC Regulatory Staff, Washington, D. C.). May 1974. 86p. Dep. NTIS $7.50.

A statistical analysis of data compiled from the service experience with steam boiler drums and other pressure vessels in United States fossil-fueled power plants is presented. The results are defined in terms of probability ranges for the occurrence of a "non-critical failure" event or a "disruptive failure" event in these "non-nuclear" vessels which were built in accordance with the ASME Boiler and Pressure Vessel Code. Non-nuclear vessels are built to codes less stringent than the code applied to nuclear vessels. However, the non-nuclear vessels operate in fossil-fueled power plants under service conditions that are comparable to those of nuclear power plants, and thus provide a basis for evaluating the probable performance of nuclear vessels. The results obtained from the non-nuclear vessel data are used to estimate the probability for the occurrence of a non-critical failure event or a disruptive failure event in nuclear reactor vessels built in accordance with the rules of the ASME Boiler and Pressure Vessel Code. (auth)

17821 CLASSROOM ADVOCACY: TOOL OR POWDERKEG. Foell, W. K. (Univ. of Wisconsin, Madison). Trans. Amer. Nucl. Soc.; 18: 39 (Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17822 ROLE OF A MOCK PUBLIC HEARING IN ENGINEERING EDUCATION. Witzig, W. F. (Pennsylvania State Univ., University Park). Trans. Amer. Nucl. Soc.; 18: 40-41 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17823 EVALUATION OF LIQUID RADIOACTIVE RELEASE FROM A STANDARDIZED NUCLEAR PLANT. Iacovino, J. M. Jr. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 42-43 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17824 COMPARISON OF CALCULATED AND MEASURED DOSES IN THE VICINITY OF A NUCLEAR POWER PLANT. Martin, J. A. Jr. (Environmental Protection Agency, Washington). Trans. Amer. Nucl. Soc.; 18: 43-44 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17825 SOCIAL IMPACTS OF NUCLEAR POWER PLANTS. Peelle, E. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 58 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17826 METHOD OF CHARACTERISTICS FOR LINEAR AND NONLINEAR FLUID-HAMMER ANALYSIS. Shin, Y. W.; Kot, C. A.; Chen, W. L.; Thompson, D. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 132-133 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17827 ENERGY RELEASE FROM MOLTEN-FUEL RE-CRITICALITY ACCIDENTS. McLaughlin, T. P.; Peterson, D. M.; Stratton, W. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 198-199(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17828 DYNAMICS OF AN HCDA BUBBLE IN THE PRIMARY CONTAINMENT. Wang, C. Y.; Chang, Y. W.; Julke, R. T. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 199-200 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17829 ANALYSIS OF THE FFTF PRIMARY CONTAINMENT MODEL EXPERIMENTS. Ash, J. E.; Gvildys, J.; Marciniak, T. J.; Nagumo, G. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 200-201(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17830 EFFECTS OF CRUSHABLE MATERIALS UNDERNEATH THE REACTOR HEAD ON COOLANT-SLUG IMPACT LOADING. Gvildys, J.; Bratis, J. C.; Chang, Y. W. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 201(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17831 THERMAL-HYDRAULIC ANALYSIS OF A PARTIALLY CRUSHED FTR-TYPE FUEL SUBASSEMBLY. Marr, W. W.; Crawford, R. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 206-207(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17832 EFFECTS OF LOCAL COOLANT FLOW DIVERSION OUT OF A 217-PIN FTR-TYPE SUBASSEMBLY. Marr, W. W.; Crawford, R. M. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 207-208(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17833 CLADDING RELOCATION EXPERIMENTS. Henry, R. E.; Jeans, W. C.; Quinn, D. J.; Spleha, E. A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 209(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17834 FLOODING CORRELATION FOR SODIUM AND CLADDING MOTION IN SUBASSEMBLY VOIDING. Grolmes, M. A.; Lambert, G. A.; Fauske, H. K. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 209-211(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17835 TREAT R5 LOSS-OF-FLOW EXPERIMENT IN COMPARISON WITH SAS PRETEST ANALYSIS. Hoeppner, G.; Chen, W. L.; Dunn, F. E.; Grolmes, M. A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 213(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17836 UO_2 SOLIDIFICATION PHENOMENA AND FRAGMENTATION DURING QUENCHING IN SODIUM COOLANT. Cronenberg, A. W.; Fauske, H. K. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 213-214(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17837 FUEL FLOW AND FREEZING IN THE UPPER SUBASSEMBLY STRUCTURE FOLLOWING AN LMFBR DISASSEMBLY. Ostensen, R. W.; Henry, R. E.; Jackson, J. F.; Goldfuss, G. T.; Gunther, W. H.; Parker, N. E. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 214-215(Jun 1974).
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17838 WORK POTENTIAL RESULTING FROM A VOIDED-CORE DISASSEMBLY. Cho, D. H.; Epstein, M.; Fauske, H. K. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 220 (Jun 1974).
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17839 DYNAMIC BEHAVIOR OF A PARTIALLY MOLTEN LMFBR CORE. Ostensen, R. W.; Jackson, J. F. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 220-221(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17840 LARGE-SCALE THERMAL-INTERACTION EXPERIMENTS WITH REACTOR MATERIALS. Winsch, I. O.; Gabor, J. D.; Henry, R. E.; Goldfuss, G. T.; Heiberger, J. J.; Quinn, D. J.; Spleha, E. A. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 221-222(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17841 TRANSIENT PHENOMENA AT THE UO_2 VAPOR/LIQUID SODIUM INTERFACE. Epstein, M.; Cho, D. H. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 222-223 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17842 BEHAVIOR OF AN LMFBR FORCED-CIRCULATION STEAM GENERATING SYSTEM DURING SELECTED TRANSIENTS. Stuteville, D. W.; di Lauro, G. F.; Palchik, D.; Hanus, N. (Combustion Engineering, Inc. Windsor, CT). Trans. Amer. Nucl. Soc.; 18: 223-224(Jun 1974).
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17843 AIRCRAFT ACCIDENT PROBABILITY DISTRIBUTION FUNCTION. Boonin, D. M. (United Engineers and Constructors, Inc., Philadelphia). Trans. Amer. Nucl. Soc.; 18: 225-226(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17844 SIMPLIFIED SMALL-BREAK BLOWDOWN MODELS. Ward, L. W. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 18: 232(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17845 COMPRESSIBLE ASPECTS OF WATER REACTOR BLOWDOWN. Hutcherson, M. N.; Henry, R. E.; Gunchin, E. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 232-234(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17846 EXPLORATORY SINGLE-TUBE TOP-FLOODING GRAVITY-FEED HEAT TRANSFER TESTS. Guerrero, H. N.; Lowe, P. A. (Combustion Engineering, Inc., Windsor, CT). Trans. Amer. Nucl. Soc.; 18: 234(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17847 SENSITIVITY STUDY ON CORE HEATUP AND MELTDOWN BY VARIATION OF HEAT CONDUCTIVITY AND THERMAL EMISSIVITY. Koerber, H.; Unger, H. E. (Univ., Stuttgart). Trans. Amer. Nucl. Soc.; 18: 234-235(Jun 1974).
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17848 APPLICATION OF THE PAJARITO DYNAMICS CODE TO ALUMINUM–WATER SYSTEMS. Hetrick, D. L. (Univ. of Arizona, Tucson). Trans. Amer. Nucl. Soc.; 18: 235-236(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17849 POWER PLANT SITING USING REMOTE SENSING. Barrett, M. J.; Lee, S. V. (Analytic Products, Inc., Bethesda, MD). Trans. Amer. Nucl. Soc.; 18: 242(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17850 SAFETY AND ENVIRONMENTAL ASSESSMENT OF UNDERGROUND NUCLEAR SITING. Doan, P. L.; Huffman, J. R.; Smith, M. H. (United Engineers and Constructors, Inc., Philadelphia). Trans. Amer. Nucl. Soc.; 18: 242-243(Jun 1974).
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17851 ROCK CAVERNS FOR NUCLEAR POWER PLANT SITING. Willett, D. C.; McCreath, D. R. (Acres American Inc., Buffalo). Trans. Amer. Nucl. Soc.; 18: 243-244(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17852 RESIDUAL ACTIVITY IN POWER REACTORS. Ray, J. H.; Krumbein, A. D. (Gulf Nuclear Fuels Corp., Elmsford, NY). Trans. Amer. Nucl. Soc.; 18: 244-245(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17853 DESIGN BASIS COASTAL FLOODING AT POWER REACTOR SITES. Noble, R. M. (Dames and Moore, Los Angeles); Tsai, Y. J.; Simpson, E. C.; Shastri Annambhotla, V. S. Trans. Amer. Nucl. Soc.; 18: 246(Jun 1974).
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17854 EVALUATION OF THE FUEL COOLANT INTERACTION SOURCE FOR FEFP LOOP DESIGN. Bezella, W. A.; Cho, D. H.; Chen, W. L. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 262(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17855 AXIAL PRESSURE TRANSMISSION FROM AN MFCI IN THE FEFP LOOP. Thompson, D. H. (Argonne National Lab., IL); Chen, W. L.; Bell, C. R. Trans. Amer. Nucl. Soc.; 18: 262-263(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17856 FUEL ASSEMBLY FINITE ELEMENT MODELING FOR SEISMIC ACCIDENT ANALYSIS. Gesinski, L. T. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 264-265(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17857 UNCERTAINTY ANALYSIS FOR REACTIVITY SURVEILLANCE IN AN LMFBR. Derby, S. L. (General Electric Co., Sunnyvale, CA). Trans. Amer. Nucl. Soc.; 18: 267(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17858 RADIAL EXPANSION REACTIVITY EFFECT IN THE FTR FOR HYPOTHETICAL UNSCRAMMED LOSS-OF-FLOW TRANSIENT. Coffield, R. D.; Starr, J. E.; Unterzuber, R. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 18: 268-269(Jun 1974).
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17859 DEVELOPMENT OF TAGGING METHOD FOR FUEL FAILURE DETECTION AND LOCATION IN LMFBR. Imani, K.; Mizuta, H.; Miyahara, K.; Isagawa, H.; Matsumoto, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Trans. Amer. Nucl. Soc.; 18: 269-270(Jun 1974).
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17860 GAS TAGGING DESIGNS FOR FUEL FAILURE IDENTIFICATION. McCormick, N. J. (Univ. of Washington, Seattle). Trans. Amer. Nucl. Soc.; 18: 270-271(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17861 PROPOSED PROTECTION SYSTEM DESIGN REQUIREMENTS. van Erp, J. B. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 271-272(Jun 1974).
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17862 APPROXIMATE METHOD FOR CALCULATING SECONDARY CRITICALITY IN LMFBR MELTDOWN ACCIDENTS. Suo-Anttila, A.; Ferrell, W.; Catton, I.; Kastenberg, W. E. (Univ. of California, Los Angeles). Trans. Amer. Nucl. Soc.; 18: 273 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17863 HEALTH PHYSICS ASPECTS OF A NUCLEAR BOILER DOWNCOMER REPAIR OPERATION. Cheifetz, A. S. (Consolidated Edison Co. of New York, Buchanan). Trans. Amer. Nucl. Soc.; 18: 355(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17864 REACTOR SITE ^{16}N SKYSHINE DOSE RATE. Steyn, J. J.; Huang, R.; Yule, H. P. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 18: 359-360(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17865 REMOVAL OF IODINE BY SPRAYS IN THE PSICO 10 MODEL CONTAINMENT VESSEL. Barsali, S.; Bovalini, R.; Fineschi, F.; Guerrini, B. Lanza, S.; Mazzini, M.; Mirandola, R. (Univ. Pisa, Italy). Nucl. Technol.; 23: No. 2, 146-156(Aug 1974).
Twelve experimental runs on molecular iodine removal by sprays were carried out in the 95 m^3 PSICO 10 model containment vessel (MCV). Both service water and a water solution containing 1% sodium thiosulphate were sprayed through two different nozzles; the elemental iodine removal half-times obtained by spraying service water do not differ greatly from those found by spraying thiosulphate solution. The sprayed solution was, in some cases, recirculated for a period ranging from 1 to 11 h without any release of iodine to the atmosphere. Some runs were performed with fractions of the MCV volume not sprayed. The elemental iodine removal half-times in the sprayed and unsprayed regions do not essentially differ. (auth)

17866 NUCLEAR SAFETY. Volume 15, No. 4. Cottrell, W. B.; Jordan, W. H.; Sheldon, M. R. (eds.). Oak Ridge, TN; Oak Ridge National Lab. (1973). 142p.
Fifteen papers are included separately in NSA on topics concerning general safety considerations, accident analysis, control and instrumentation, plant safety features, consequences of activity release, and operating experiences. (DCC)
For abstracts of individual papers see: 15088, 15879, 16495, 17591, 17867–17873, 17941, and 18011–18013.

17867 AEC STUDY ON THE ESTIMATION OF RISKS TO THE PUBLIC FROM POTENTIAL ACCIDENTS IN NUCLEAR POWER PLANTS. Rasmussen, N. C. (Massachusetts Inst. of Tech., Cambridge). Nucl. Safety; 15: No. 4, 375-383(1974).
The U. S. Atomic Energy Commission initiated a reactor safety study in September 1972 to estimate the probability of occurrence of various potential accidents in light-water nuclear power plants and of their consequences. The study is divided into seven major tasks, including such topics as the identification of accident sequences, the assignment of probabilities, fission-product transport in each accident sequence, fission-product distribution in the environment, health effects and property damage, nonnuclear risks, and interpretation and communication of the meaning of low-probability events to nontechnical readers. A final report is expected in the summer of 1974. (auth)

17868 PRESSURE-VESSEL-FAILURE STATISTICS AND PROBABILITIES. Nucl. Safety; 15: No. 4, 387-398(1974).
Vessel failure is defined as a condition in which a crack, leak, or other defect has developed in the pressure-retaining components of the vessel, so that repair or replacement of the vessel is required. Two major categories of vessel failure are considered, disruptive and nondisruptive; nondisruptive vessel failures are further subdivided into potentially disruptive and noncritical. Statistics concerning U. S. and foreign pressure vessel failures are compared. Differences between the nonnuclear pressure vessels and reactor pressure vessels in terms of design and operating conditions are pointed out. Probabilities for reactor pressure vessel failures are presented. (12 references) (DCC)

17869 PROBABILISTIC ASSESSMENT OF FLOODING HAZARD FOR NUCLEAR POWER PLANTS. Wall, I. B. (Imperial Coll. of Science and Tech., London). Nucl. Safety; 15: No. 4, 399-408(1974).
A method is described for estimating the potential hazard to a nuclear power station from major flooding of a nearby river. The method, applied to the Monticello reactor site for illustration, uses historical data to estimate both the probable magnitudes and the probabilities of occurrence of floods during the 50-year life of the plant. This approach avoids the long extrapolations from limited data associated with attempts to estimate the magnitude of the probable maximum flood, which may have a return period of 10,000 years, and permits the calculation of confidence limits associated with deviation from the expected behavior. On the basis of estimates of potential effects, it is concluded that a reasonable nuclear-plant design basis would be the flood magnitude with an occurrence probability of 10^{-4} to 10^{-5} during the next 50-year period. (20 references) (auth)

17870 PENETRATION TESTING FOR THE DETERMINATION OF PROPERTIES OF SOILS. Robinson, G. C. Jr. Nucl. Safety; 15: No. 4, 423-431(1974).
Safe performance of many nuclear power plants is inherently related to soil behavior, particularly as affected by the loadings that earthquakes may impose. Sites with competent rock foundations will be increasingly difficult to acquire because of interrelations with environment, load location, and economic factors.

Consequently the techniques used for assessing soil properties constitute an integral part of the interdisciplinary review of such facilities. Although standard penetration testing is one of the most widely used techniques for assessing soil properties, its limitations are not well understood. These limitations are reviewed and recommendations whereby more quantifiable soil tests may be possible are presented. (49 references) (auth)

17871 TORNADO-RESISTANT DESIGN OF NUCLEAR POWER-PLANT STRUCTURES. McDonald, J. R.; Mehta, K. C.; Minor, J. E. (Texas Tech. Univ., Austin). Nucl. Safety; 15: No. 4, 432-439(1974).

The various factors involved in tornado-resistant design are reviewed. The FPP scale ratings of storms and the record-keeping efforts of the National Severe Storms Forecast Center in Kansas City, Mo., have generated data that provide a more concise understanding of the geographical distributions of tornadoes and their intensity. Such data have resulted in useful regional criteria for the design of tornado-resistant nuclear plants. The AEC design-basis tornado and its implications are discussed, with specific reference to occurrence and intensity data, tornado-wind models, tornado-structure interaction, and tornado-generated missiles. The use of tornado-wind models represents a rational approach to determining the forces on structures and also provides data for evaluating the flight potential of missiles. Tornado-structure interaction, the phenomenon whereby the meteorological effects are translated into loads on the structure, is discussed at length. A clear understanding of these loads can lead to economy of construction without compromising safety. Currently there are many questions relating to design for tornado-generated missiles. Hopefully future research in this area will lead to an understanding of the phenomenon and allow a relaxing of the missile criteria. (19 references) (auth)

17872 RECENT OCCURRENCES AT NUCLEAR REACTORS AND THEIR CAUSES. Casto, W. R. (comp.). Nucl. Safety; 15: No. 4, 466-477(1974).

All reports of occurrences that were abstracted for the Nuclear Safety Information Center at Oak Ridge National Laboratory in March and April 1974 were scanned for the information given. A brief description of each incident is included, along with the reactor, facility, or institution at which the incident occurred. The docket number and the date of the report are included where appropriate so that interested readers may obtain copies of the reports from the AEC Public Document Room in Washington, D. C. Each reactor installation has its own docket number in the filing system at the Public Document Room. (auth)

17873 SELECTED SAFETY-RELATED OCCURRENCES REPORTED IN MARCH AND APRIL 1974. Casto, W. R. (comp.). Nucl. Safety; 15: No. 4, 478-481(1974).

Of the safety-related occurrences reported in March and April, the following are discussed in detail here because of their frequency, uniqueness, or significance. During one of the occurrences, an operator was injured while checking out a leak in a substmospheric-pressure containment building. The other incidents were less unique but, nevertheless, interesting and instructive. A gamma source was improperly shielded during shipment by air, explosions occurred in the off-gas systems of two boiling-water reactors (BWRs), voltage oscillations at a pressurized-water-reactor (PWR) station caused power interruptions on the grid, and there was a puzzling operation of a high-pressure coolant-injection system during a test at a BWR plant. (8 references) (auth)

17874 PROBABILISTIC ASSESSMENT OF THE FREQUENCY OF AIRCRAFT CRASHES ON NUCLEAR POWER PLANTS. Fuerste, W. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (F. R. Germany)); Glupe, G. (Babcock-Brown Boveri Reaktor G.m.b.H., Mannheim (F.R. Germany). Fachbereich Technik). Tech. Ueberwach.; 15: No. 4, 115-119 (Apr 1974). (In German).

6 figs.; 3 tabs.; 12 refs.

The discussion about safety criteria, their assessment and definition has been reanimated by the fact that due to increased energy demand, the network of nuclear power plants is to be extended considerably. One of the main aspects of the utilization of nuclear energy of interest to the general public is the protection of nuclear power plants from external impacts. The aircraft hazard for nuclear power plants is determined by the type and volume of air traffic within the area of nuclear power plant sites. The nuclear power plant Unterweser has been taken as example in the present contribution to assess the risk of aircraft crashes and the aircraft hazard for nuclear installations. (GE)

17875 DESIGN OF THE PRIMARY CONTAINMENT FOR POOL AND LOOP ARRANGEMENTS OF LMFBRs. Huebel, H. (Internationale Atomreaktorbau GmbH, Bensberg, Ger.); Koehler, M.; Lange, L.; Cobb, E. C.; Leigh, K. M. Nucl. Eng. Des.; 27: No. 2, 139-154(1974).

The relationship between LMFBR primary system concepts and the possibilities of limiting the consequences of a hypothetical whole-core accident is discussed. Three modes of loading phenomena are considered: (1) the transient pressures due to expansion of a vaporized fuel; (2) the transient pressures given by a coherent sodium-fuel interaction; and (3) the equilibrium pressure given by transferring the excess heat in the fuel to an amount of sodium which produces the highest possible quasi steady-state pressure in the system. The structural response of the pool and loop systems is studied with respect to salient modes (2) and (3). (auth)

17876 ANALYSIS OF THE PRIMARY CONTAINMENT RESPONSE USING A HYDRODYNAMIC-ELASTIC-PLASTIC COMPUTER CODE. Chang, Y. W.; Gvildys, J.; Fistedis, S. H. (Argonne National Lab., IL). Nucl. Eng. Des.; 27: No. 2, 155-175(1974).

The dynamic response of the primary reactor containment system to a hypothetical core disruptive accident (HCDA) is determined from the basic equations of mass, momentum, and energy, and the equations of state of the medium. These equations are first expressed in material coordinates and then set into finite difference form solved numerically on the computer using a hydrodynamic-elastic-plastic computer code, REXCO-HEP. Propagation of pressure waves, loads imposed on different parts of the reactor components, and the resulting deformations are determined at every time step throughout the sequence of the calculation. As a sample calculation, the code was applied to analyze the response of the FFTF reactor to a 150 MWsec HCDA. The mathematical model is described in detail, particularly in the areas of modeling reactor internals and extending the time range to cover the entire excursion phenomenon. The results obtained from the computer analysis are discussed in detail. (auth)

17877 GENERATION AND PROPAGATION OF PRESSURE WAVES DUE TO UNCONFINED CHEMICAL EXPLOSIONS AND THEIR IMPACT ON NUCLEAR POWER PLANT STRUCTURES. Geiger, W. (Battelle-Inst. eV, Frankfurt am Main). Nucl. Eng. Des.; 27: No. 2, 189-198(1974).

In the field of external reactor safety-possible violent incidents outside the reactor building need to be assessed with regard to their potential for doing damage to nuclear power plants. The generation and propagation of pressure waves due to unconfined chemical explosions and their impact on nuclear power plant structures are discussed. A survey is made of the procedures by which the effects of gas explosions on nuclear power plant structures can be assessed. (auth)

17878 DYNAMIC TESTING OF FULL-SCALE NUCLEAR POWER PLANT STRUCTURES AND EQUIPMENT. Smith, C. B. (Applied Nucleonics Co., Inc., Los Angeles). Nucl. Eng. Des.; 27: No. 2, 199-208(1974).

Three steps are required in the design of reliable nuclear power plants to be located in seismic areas. In addition to development of realistic analytical models, it is necessary to perform dynamic tests to verify the models and acquire the information needed to establish the dynamic parameters for modeling. The third and final step is to perform high level proof tests to validate analysis and test results. An overview of dynamic testing methods is presented. Testing can be performed in the laboratory or in the field. Laboratory tests are useful because a wide range of effects can be studied and test parameters are more easily controlled. Care must be exercised to insure that the laboratory situation faithfully reproduces the actual structure in such details as supports, appurtenances, appendages, and mounting methods. In general, laboratory methods permit high level excitation of structures weighing up to a few metric tons (a few facilities in the world have capabilities up to 100 t). Since actual structures of interest to nuclear power plant designers often weigh up to 10,000 t, field testing is also important. Test procedures have been developed, using portable structural vibrators, for testing structures as large as nuclear power plant containment buildings. High level tests can be performed using explosives buried in the soil to excite structures. Recent work demonstrates that explosive tests which produce a predetermined, specified response spectrum can be conducted. (auth)

17879 METHODS FOR THE IDENTIFICATION OF DYNAMIC PARAMETERS OF MATHEMATICAL STRUCTURAL MODELS FROM EXPERIMENTAL DATA. Ibanez, P. (Applied Nucleonics Co., Inc., Los Angeles). Nucl. Eng. Des.; 27: No. 2, 209-219 (1974).

The dynamic analysis of complex and critical structures, such as nuclear power plants, must employ not only both theoretical and

experimental analysis, but also combine these two approaches to provide a unified description of the structure. A theoretical a priori model is useful in planning a vibration test, while the data obtained from such testing can be used to modify the a priori model so that it reproduces the experimental data. Several mathematical methods are presented which are useful in planning and placement of exciters and accelerometers; in analyzing data to identify resonant frequencies, modal damping and mode shapes; in modifying the mass and stiffness properties of the a priori model (consequently indicating improved methods of modeling in future studies); and in identifying unknown forces acting on the structure, once a good model has been obtained. Central to these methods is the use of a generalization of the inverse of a matrix—the pseudo-inverse and the availability of efficient computer software for its computation. The properties of the pseudo-inverse allow it to calculate weighted least-mean-square and weighted minimum-norm solutions to ill-conditioned linear systems. It is consequently a versatile tool in the analysis of vibrating systems where the number of measurement and forcing points is often different and the confidence in different measurements and models varies. (auth)

17880 TAETIGKEITS-BERICHT, 1973. (Annual Report 1973). Cologne; Technische Oberwachungs-Vereine eV (1974). 121p.

The organizational development during the year is summarized. The primary projects of the design, components and systems, operational techniques, and control and maintenance sections are outlined. Approval studies are indicated. Participation in national and international cooperative efforts and conferences is reported. The reports and publications issued during the year are tabulated. (JSR)

17881 COMPARATIVE FORCED VIBRATION TEST OF TWO BWR-TYPE REACTOR BUILDINGS. Muto, K. (Muto Inst. of Structural Mechanics, Inc., Tokyo); Hayashi, T.; Omatsuzawa, K.; Ohta, T.; Uchida, K.; Kasai, Y. Nucl. Eng. Des.; 27: No. 2, 220-227(1974).

Forced vibration testing of two GE 460 MW(e) BWR-type reactor buildings is described. The tested nuclear power plants are the Fukushima Nuclear Power Plant Unit No. 1 of the Tokyo Electric Power Company and the Shimane Nuclear Power Plant of the Chugoku Electric Power Company. They are almost the same in both structure and function, but are built on rock of quite different rigidity. The shear wave velocity of Shimane is about three times that of Fukushima. The forced vibration tests were performed immediately after completion of each reactor building using a vibrator with a maximum exciting force of 3 t. The computer simulation analyses were carried out using vibration models possessing different internal viscous damping factors for each structural element. Both the resonance periods and damping factors of Fukushima were found to be larger than those of Shimane. Thus, site selection of nuclear power plants must be reviewed as a matter of utmost importance from the viewpoint of seismic design. (auth)

17882 ELASTIC-PLASTIC DEFORMATION OF CYLINDRICAL PRESSURE VESSELS UNDER CYCLIC LOADING. Chang, T. Y. (Akron Univ., OH); Chu, S. C. Nucl. Eng. Des.; 27: No. 2, 228-237(1974).

A numerical procedure based on the finite element method and incremental solution approach is presented for analyzing cylindrical pressure vessels deformed in the state of generalized plane strain. The structures considered are subjected to internal pressure, thermal gradients and axial forces, which are cyclic in nature. The materials are assumed to obey the von Mises yield criterion with kinematic strain hardening which, during the process of plastic deformation, the yield surface is permitted to translate in the stress space and may change its size as a function of temperature. Based on Drucker's postulates for stable materials in the incremental theory of plasticity, a nonisothermal flow rule is deduced in the cylindrical coordinates. By use of the virtual work principle, the finite element equations with displacement formulations are derived. The numerical solution is then carried out by a step-by-step approach for small loading increments and an iteration scheme is employed for each loading step. Furthermore, the analysis method is extended to the determination of limit load and shakedown load of a vessel. Several problem cases are presented. (auth)

17883 DESIGN RELATIONSHIPS AND FAILURE THEORIES IN PROBABILISTIC FORM. Smith, C. O. (Univ. of Detroit). Nucl. Eng. Des.; 27: No. 2, 286-292(1974).

The engineering profession has become increasingly concerned with the adequacy of design calculations. This concern indicates a need for critical evaluation of designs based on arbitrary multipliers, such as safety factors or worst-case treatment. Design has customarily been based on applied loading, geometry, and handbook property values to give a deterministic solution. The Soderberg, Goodman, Gerber, and elliptical design relationships and the maximum shear and distortion energy failure theories are presented in probabilistic form. Inherent in the equations are the facts that (a) design variables are generally characterized by spectra of values, rather than unique values; and (b) a small, but finite, probability of failure must be recognized in any design. By coupling the mean static and mean alternating stresses (and their standard deviations) with the strengths available in a material (and their standard deviations) in one of the four design relationships using an appropriate theory of failure, the reliability of a given design can be calculated. Conversely, for a given reliability, the appropriate size can be determined. Illustrations are provided. The influence of range (different standard deviations) of variables on reliability is demonstrated. A comparison is made between safety factor and reliability. (auth)

17884 MODEL RESEARCH ON A PRESTRESSED CONCRETE PRESSURE VESSEL FOR A NUCLEAR POWER STATION. Monnier, T.; Schnackers, P. J. H. Heron (Engl. Ed.); 18: No. 3, 3-44(1972).

The object of the experimental research described was to determine the nature of failure, the failure mechanism, and the ultimate pressure of a pressure vessel for a gas-cooled nuclear reactor. All previous tests on such vessels used hydraulic means to pressurize the vessel, and consequently failures did not show explosive characters. The research described relates to a realistic model which was loaded by internal gas pressure. The vessel under consideration was a vertical cylinder with a bottom slab and a cover slab at its ends. Both vertical and horizontal prestresses were applied by steel wires 3 millimeters in diameter. The quantity of prestressing steel was such that alone it would just be able to resist the forces occurring when three times the working pressure was applied. The magnitude of the prestress applied in the wires was such that the largest tensile stress in the vessel caused by the working pressure and the temperature gradient could be entirely cancelled by prestress. The prestressing forces were computed taking into account an average frictional loss of 15 percent. The untensioned reinforcing steel installed near the outer and inner surfaces of the wall was provided in order to distribute any cracking due to shrinkage of the concrete and/or stress concentrations. The quantity of such steel in the two end slabs was so determined that at the failure stage the entire shear force could still just be resisted by this steel. The model was made of microconcrete using high-alumina cement. As interest was focused on the overall behavior of the vessel the various apertures through the wall which are present in real vessels were omitted in the model. The test was performed at normal ambient temperature. Only the overall deformations in the vertical and in the horizontal direction were recorded at the various values of the internal pressure. Failure of the model occurred at an internal pressure of 129 kg/cm^2 and was marked by a violent explosion. The actual margin of safety of 3.2 was exactly the predicted value. It appears very probable that the direct cause of explosive failure of the vessel was fracturing of the liner, immediately followed by fracturing of prestressing steel. Despite the explosive character of the failure, it cannot be regarded as "sudden failure" since there was considerable increase in the deformation after cracking and before failure occurred. The view that the hazard of explosive failure of such vessels is negligible is shown to be incorrect by this research. The design and the building of the model and also the testing procedure are described thoroughly. (App. Mech. Rev.)

17885 CHOICE OF NUCLEAR POWER PLANT SITES. Aussourd, P. (Ministere du Developpement Industriel et Scientifique, Paris); Candes, P. Ann. Mines; No. 1, 71-76(Jan 1974). (In French).

A review is presented of the factors that must be taken into consideration when choosing nuclear plant sites, 20 to 25 of which must be found in France before the year 2000. Electricity production and environmental protection are considered from two points of view: impact of the plant on the environment; effect of constraints imposed by the site on the plant. (FR)

17886 ENVIRONMENTAL IMPACT ASSESSMENT OF NUCLEAR POWER GENERATION FACILITIES: A CASE EXAMPLE. Raines, G. E. (Battelle Columbus Labs., OH). pp 123-129 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

A procedure developed for assessing the environmental impact of nuclear power plants is described in detail, and its application for predicting environmental impact is illustrated using the Indian Point-2 plant on the Hudson River as an example. This method

for evaluating environmental impact is structured around a matrix approach in which the effects of the plant operation on the surrounding environmental conditions and components are tabulated in a systematic manner and, considering alternative modes of plant operation, the number values for insertion in the matrix are obtained by developing weighted value functions for each category. The categories in the impact matrix include: the chemical and physical properties of the area atmosphere, soils, surface waters, and ground water; aquatic, terrestrial and atmospheric biological conditions; utilization of soil, air, and water in the region, and cultural conditions which are considered to include health and safety conditions, aesthetics, and interaction with manmade facilities. For the example used, it was concluded that the use of cooling towers, as compared with once-through cooling, would result in a higher total environmental cost. (LCL)

17887 RADIOLOGICAL IMPACT OF PRIMARY TO SECONDARY LEAKAGE IN A PRESSURIZED WATER REACTOR. Vineberg, E. J. (Applied Nucleonics Co., Inc., Los Angeles). pp 136-140 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

A mathematical model has been derived to evaluate the consequences of a primary to secondary leak in the steam generator of a pressurized water reactor. The case considered in and the results shown pertain to a specific reactor. However, the general method of analysis presented may be applied to any appropriate PWR facility, and the results will be similar to those shown. From the specific results presented, a few general conclusions were drawn. First, in evaluating the seriousness of an actual or potential primary to secondary leakage problem, there is no single critical parameter. Rather, it is the combination of the primary coolant activity concentration and the primary to secondary leak rate which will determine the severity of the problem. Second, if reactor operations are to be allowed to continue with an existing primary to secondary leak, the leak rate will be limited to less than ~0.1 gpm; this is under almost perfect fuel cladding integrity conditions (~10^{-3}% defective fuel). Under the design conditions of 1% defective fuel, the "permissible" primary to secondary leak rate will be limited to between 10^{-4} and 10^{-3} gpm. Leak rates in excess of these limits will lead to excessive discharges of radioactive liquid waste. Third, the off-site dose rates due to the gaseous releases which will occur as the result of a primary to secondary leak can be significant and should be considered in determining whether operation of the plant will be allowed to continue. (auth)

17888 EARTHQUAKE SIMULATION USING THE SINE-BEAT METHOD. Fandrich, R. T. Jr. (Radiation Inc., Melbourne, FL). pp 183-186 of Realism in Environmental Testing and Control. Mt. Prospect, IL; Inst. of Environmental Sciences (1973).

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973). See CONF-730401-.

The application of a Sine-Beat pulse to a large test item to simulate the environment and damage potential of an earthquake is described. The test item was a Unit Electrical Control Corporation nuclear power plant control panel and the test performed was in compliance with IEEE STD 344-1971 Guide for Seismic Qualification of Class I Electric Equipment for Nuclear Power Generating Stations. The test environment is described and compared to actual earthquake environment. The various methods used to obtain the environment are discussed and the details of the actual test program are explained, including the fixturing and handling of the 2700 pound test item. (auth)

17889 SEISMIC TEST OF ELECTRIC EQUIPMENT FOR NUCLEAR POWER STATIONS. Yashima, H. (Mitsubishi Electric Corp., Tokyo). Mitsubishi Denki Giho; 48: No. 3, 351-359(Mar 1974). (In Japanese).

In nuclear power plants the proper functioning of reactor control and containment system components under seismic conditions is of paramount importance. Vibrational tests were conducted on some typical control boards, switchgears, and components such as relays in order to investigate the seismic capabilities of the equipment. The equipment functioned properly even when subjected to seismic conditions more severe than those likely to be encountered at nuclear power plants. (JA)

17890 EXAMPLE OF THE EVALUATION OF FATIGUE STRENGTH OF A HIGH TEMPERATURE STRUCTURE BY ASME CODE. Sakano, K.; Torii, H. (Kawasaki Heavy Industries, Ltd., Kobe, Japan). FAPIG (Tokyo); No. 69, 23-29(May 1973). (In Japanese).

Stress analysis of an LMFBR steam generator under transient conditions following loss of flow was conducted to obtain design criteria for high temperature structures. The finite element method was used in calculating time-dependent elastic and inelastic stresses. In each case, the maximum stress occurred at the inner wall behind the outlet nozzle. Inelastic stress was found to be more severe than elastic stress, the permissible repetition numbers being 3.3×10^3 and 5×10^4, respectively. (JA)

17891 NUCLEAR POWER PLANT INSURANCES 1974. Braun, H. Versicherungswirtschaft; 29: No. 2, 92-94(Jan 1974). (In German).

A brief survey is given of the present situation and problems encountered in nuclear power plant insurance in the Federal Republic of Germany. Topics discussed are: (1) the insurance to be effected by the vendor covering the period from the beginning of construction to the first fuel loading, (2) the insurance covering the period between fuel loading and reactor commissioning, and (3) the insurance effected by the reactor operator after commissioning. The role of the underwriter is also discussed. (GE)

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Refer also to abstracts 17672, 17748, and 17786.

17892 (AED-CONF-74-2-5) USE OF TRANSIENT MODELS IN SYSTEM ANALYSIS. Frisch, W.; Hoeld, A. 1974. 4p. (In German). INIS.

From second information meeting of the Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching (LRA). Main Topic: Systems Analysis and Reliability Engineering; Muenchen, F. R. Germany (16 Jan 1974).

Transient models developed in connection with reactor and system dynamics problems are described. The different mathematical models reviewed are classified as linear system models, non-linear core models and non-linear system models. (INIS)

17893 (AREAEE-172) STUDY OF SLOW NEUTRON SPACE-ENERGY DISTRIBUTIONS IN WATER NEAR CADMIUM, BORON-CARBIDE AND COPPER ROD ELEMENTS. Hussein, A.; Eid, Y.; Abdel Kawi, A.; Zakharkin, I.; Hamouda, I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 46p. Dep. NTIS (U. S. Sales Only) $5.50.

Results are reported of vectorial neutron spectra measurements near cadmium, boron carbide, and copper rod elements immersed in water. Neutron spectra were measured for those neutrons directed, in moderator, normally with respect to the rod and at various distances from the rod. Use is made in the measurements of a mechanical neutron selector. The research reactor, ET-RR-1, served as the neutron source. The results for cadmium and boron carbide rods display an appreciable softening of the thermal neutron spectrum. The boron carbide rod is characterized, in addition, by some specific features of spectrum behavior in the resonance region as well. In the proximity of the copper rod, however, a pronounced hardening of the directed flux which diminishes with the distance from the rod is observed. Experimental results for the copper rod are compared with multigroup calculations and good agreement is reported. The realistic liquid model is found to yield better results in calculations than the free-gas model. (auth)

17894 (AREAEE-173) STUDY OF ANGULAR-SPACE-ENERGY DISTRIBUTIONS OF SLOW NEUTRONS IN WATER NEAR PLANE ABSORBER. Hussein, A.; Eid, Y.; Zakharkin, I.; Hamouda, I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 28p. Dep. NTIS (US Sales Only) $4.50.

Spectral measurements were made of neutrons directed parallel to (grazing incidence) and normally upon a cadmium plate. Perpendicular leakage spectra were also measured. The normal spectra were measured at distances of 0.25, 0.5, 1.0, 1.5, 3.0, and 5.0 cm from the plate. The parallel spectra were measured at 0.65 and 1.5 cm. Spectral hardening effects were observed near the plate surface. The normal spectra measured at 0.25, 0.5, 1.0, and 1.5 cm were compared with one-dimensional multigroup calculations based on the Nelkin model for water. The agreement is good, indicating a realistic theoretical description of the thermalization process near a plane absorber. Interpretation of the results in terms of a neutron temperature approximation permits a direct estimation of the extent of spectral hardening near the plate. The hardening was most pronounced for the leakage spectrum whose temperature is 70° higher than that of the asymptotic spectrum. (auth)

17895 (AREAEE-176) USE OF P_3-MODEL AND HEAVY GAS-KERNEL IN NEUTRON THERMALIZATION OF SPHERICAL WATER SYSTEMS. Hathout, A. M.; Nassar, S. F. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 36p. Dep. NTIS (U. S. Sales Only) $5.00.

The time decay constant for spherical homogeneous light water

systems in the range of buckling B^2 from 0.0 to 1.0 cm^{-2} was calculated using the P_3-L_1 approximation. The heavy gas model was employed. The curve of the fundamental decay constant versus buckling has a negative curvature at the origin showing that the model in question could reveal a neutron cooling phenomenon that takes place in finite systems. The calculated values of the lowest time-eigenvalue were found to be in excellent agreement with available experimental data over the range of buckling investigated. Behavior of the higher modes of the decay constants differs in the P_3-L_1 approximation from the P_1-L_1 approximation. (auth)

17896 (AREAEE-181) ODC: A ONE-DIMENSIONAL, MULTI-GROUP, DIFFUSION CODE, USING ICL-1905E COMPUTER. Sabek, M. G.; Hamouda, I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 21p. Dep. NTIS (U. S. Sales Only) $4.25.

The ODC is a one-dimensional, multi-group, diffusion criticality code. It is written in the ALGØL language for the ICL-1905E computer and is based upon the WANDA code written in FØRTRAN for the IBM-704 computer. The code solves the eigenvalue problem for the diffusion equations for slab, cylindrical, and spherical geometry. A block diagram of the computer program is given. (auth)

17897 (DP-MS-74-14) THERMAL DATA TESTING OF ENDF/B-III AND PROGNOSIS FOR ENDF/B-IV. McCrosson, F. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 23p. (CONF-740608-13). Dep. NTIS $4.25.

From annual meeting of the American Nuclear Society; Philadelphia, Pennsylvania, USA (23 Jun 1974).

Thermal benchmark experiments on uranyl nitrate spheres, H_2O and D_2O uranium lattices, and plutonium nitrate spheres were analyzed to check the accuracy of ENDF/B III cross sections and to assist evaluators in preparing ENDF/B IV data files. (JWR)

17898 (EIR-248) SOLUTION OF THE COUPLED INTEGRAL AND DIFFERENTIAL FORM OF THE TRANSPORT EQUATION USING A LEGENDRE POLYNOMIALS SOURCE DENSITY APPROXIMATION IN ANGLE AND SPACE FOR SLAB GEOMETRY. Stepanek, J.; Ligou, J. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jan 1974. 49p. (CONF-721018-28). Dep. NTIS (US Sales Only) $5.50.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

Neutron source density approximations in angle and space using a Legendre polynomial expansion are used for solving the integral transport equation in one-dimensional multilayer slab geometry. Different expansions are used for each layer. The number of integral equations is limited because a set of differential equations is used at the same time. The SHERLOCK code based on this method was written mainly for shielding problems, but reactor or cell calculations are also possible. Several numerical applications are given: neutron spectra in light water, neutron penetration in iron-water shieldings, etc. (auth)

17899 (FTD-MT-24-802-74) COMPARISON OF THE POINT AND SPACE KINETICS MODELS IN A URANIUM HYDRIDE REACTOR. Mogil'ner, A. I.; Dimeshi, Z.; Kolosov, B. I.; Krivelev, G. P.; Morozov, S. A.; Satmari, Z.; Semenov, G. F.; Stepanov, A. N.; Shvetsov, D. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1969. Translation of FEI-177. 31p.

An attempt was made to experimentally establish the limits of applicability of the point model for beryllium-reflected uranium hydride reactor. Experiments performed with a pulsed neutron generator were analyzed by statistical methods. It was concluded the point kinetics model satisfactorily describes experimental results during times commensurable with the reciprocal value of the basic decay constant for prompt neutrons. (JWR)

17900 (KFK-1883) MEASUREMENT OF β_{eff} OF THE ASSEMBLIES SNEAK-7A AND -7B AND MASURCA R2 BY THE FREQUENCY ANALYSIS OF NEUTRON NOISE. Vaeth, W. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Feb 1974. 15p. (In German). Dep. NTIS (US Sales Only). $4.00.

To understand the discrepancy between the measured and calculated reactivity worths in plutonium fueled reactors, the effective fraction of delayed neutrons was measured by the frequency analysis of neutron noise. In order to do this (assuming validity of the point reactor model) it is necessary to know only the total fission rate. In addition the space and energy effects of the neutron flux were taken into consideration by introducing a factor into the correlation function. The measured value of β_{eff} agrees well with the results of other experimental methods, indicating a theoretical underestimation of this parameter. (auth)

17901 (N-73-33594) MEASURED AND CALCULATED FAST NEUTRON SPECTRA IN A DEPLETED URANIUM AND LITHIUM HYDRIDE SHIELDED REACTOR. Lahti, G. P.; Mueller, R. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Oct 1973. 15p. (NASA-TM-X-2906; E-7485). NTIS $2.75.

Measurements of fast neutrons were made at the surface of a lithium hydride and depleted uranium shielded reactor. Four shield configurations were considered; these were assembled progressively with cylindrical shells of 5-centimeter-thick depleted uranium, 13-centimeter-thick lithium hydride, 5-centimeter-thick depleted uranium, 13-centimeter-thick lithium hydride, 5-centimeter-thick depleted uranium, and 3-centimeter-thick depleted uranium. Measurements were made with a NE-218 scintillation spectrometer; proton pulse height distributions were differentiated to obtain neutron spectra. Calculations were made using the two-dimensional discrete ordinates code DOT and ENDF/B (version 3) cross sections. Good agreement between measured and calculated spectral shape was observed. Absolute measured and calculated fluxes were within 50 percent of one another; observed discrepancies in absolute flux may be due to cross section errors. (auth)

17902 (ZJE-142) DYNAMIC METHODS OF DETERMINING REACTOR REACTIVITY. Grof, V.; Kalivoda, R. (Skoda, Plzen (Czechoslovakia)). 1973. 29p. Dep. NTIS (US Sales Only) $4.50.

Two methods of dynamic determination of reactivity based on reactor kinetics equations are described. The methods differ in the way of their derivations and in the choice of simplifications. Both methods are compared from the viewpoint of static and dynamic accuracy and the possibility of process control computer application. The experiments are carried out on a reactor analog computer model and on the reactors SR-OA and A1. The results of experiments are processed on digital computers. (auth)

17903 CROSS-FLOW APPROXIMATIONS USED IN THE THERMAL-HYDRAULIC MULTICHANNEL ANALYSIS. Sha, W. T.; Szewzyk, A. A.; Schmitt, R. C.; Hughes, T. H.; Huebotter, P. R. (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 134-135(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17904 DEVELOPMENT AND IMPLEMENTATION OF AN ON-LINE FOURIER ANALYZER BASED ON THE GOERTZEL METHOD. Piety, K. R.; Kerlin, T. W.; Shahrokhi, F. (Univ. of Tennessee, Knoxville). Trans. Amer. Nucl. Soc.; 18: 139-140 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17905 GENERALIZED PADE AND CHEBYSHEV APPROXIMATIONS FOR POINT KINETICS. Hennart, J. P.; Torres B., B. (Instituto Politecnico Nacional, Mexico City). Trans. Amer. Nucl. Soc.; 18: 151-152(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17906 COARSE-MESH METHOD FOR SPACE-TIME KINETICS. Birkhofer, A.; Langenbuch, S.; Werner, W. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). Trans. Amer. Nucl. Soc.; 18: 153-154(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17907 NUMERICAL COMPUTATIONS WITH FOURIER REPRESENTATIONS OF DISCONTINUITIES IN REACTOR ANALYSIS. Dubois, G. (Univ. of Montreal, Canada). Trans. Amer. Nucl. Soc.; 18: 157-159(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17908 APPROXIMATE TREATMENT OF RESONANCE EFFECTS IN LATTICES. Copenhaver, C. M. (Univ. of Tennessee, Knoxville). Trans. Amer. Nucl. Soc.; 18: 317-318(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17909 MEASURED AND CALCULATED HEAVY-ISOTOPE CONCENTRATIONS AND FISSION PRODUCT POISONING IN IRRADIATED ^{233}U. Gunst, S. B.; Connor, J. C.; Conway, D. E. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 18: 330-331(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17910 TRANSIENT SOLUTIONS OF THE NONLINEAR NUCLEAR REACTOR WITH VARIOUS FEEDBACKS. Nguyen, D. H. (Naval Postgraduate School, Monterey, CA). Trans. Amer. Nucl. Soc.; 18: 322-323(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17911 SUMMATION-EXPONENT ANALYSIS FOR SPACE-DEPENDENT REACTOR TRANSIENTS. Garland, W. J.; Vlachopoulos, J.; Harms, A. A. (McMaster Univ., Hamilton, Ont.). Trans. Amer. Nucl. Soc.; 18: 323-324(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17912 HIGHER ORDER RELATIONSHIP BETWEEN STATIC POWER TILTS AND EIGENVALUE SEPARATION. Beckner, W. D.; Rydin, R. A. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc.; 18: 324(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17913 INTEGRAL TESTS OF FISSION PRODUCT DATA FILES. England, T. R.; Harris, D. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 331-332(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17914 NEW TECHNIQUE FOR MEASURING THE DOPPLER EFFECT. Banharnsupavat, S. (Univ. of Missouri, Columbia); Parkinson, T. F.; Harvey, J. A. Trans. Amer. Nucl. Soc.; 18: 332-333(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17915 REQUIREMENTS FOR SENSITIVITY STUDIES IN REACTOR PHYSICS. Hemmig, P.; Lewellen, J.; Lowery, V. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 335(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17916 DETERMINISTIC AND PROBABILISTIC UNCERTAINTIES IN SENSITIVITY STUDIES. Hwang, R. N.; Henryson, H. H. II (Argonne National Lab., IL). Trans. Amer. Nucl. Soc.; 18: 338-340(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17917 CONSISTENCY AMONG DIFFERENTIAL NUCLEAR DATA AND INTEGRAL OBSERVATIONS. Harris, D. R. (Los Alamos Scientific Lab., NM). Trans. Amer. Nucl. Soc.; 18: 340-341(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17918 ANALYSIS OF TRX LATTICES WITH ENDF/B DATA. Hardy, J. Jr. (Westinghouse Electric Corp., West Mifflin, PA). Trans. Amer. Nucl. Soc.; 18: 351-352(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17919 THERMAL DATA TESTING OF ENDF/B-III AND PROGNOSIS FOR ENDF/B-IV. McCrosson, F. J. (Savannah River Lab., Aiken, SC). Trans. Amer. Nucl. Soc.; 18: 352-353(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17920 RESPONSE-MATRIX METHOD FOR SPACE-DEPENDENT NUCLEAR-REACTOR KINETICS CALCULATIONS. Sicilian, J. M. Stanford, CA; Stanford University (1973). 101p. University Microfilms Order No. 74-6550.

Thesis (Ph. D.).

A response-matrix formulation of the reactor-kinetics equations is developed and applied to some simple, one-dimensional problems. The essence of the technique is the decomposition of the reactor into a system of sub-assemblies, or cells. Given the time-dependent surface-to-surface Green's function for each of these cells, one can obtain an integral equation (over six variables) for the angular neutron flux on the cell surfaces. Approximation of the space, energy, and angle dependence of the flux, by standard nodal or modal methods, reduces the equation to a matrix Volterra-integral equation in time, which may be solved by any of several numerical methods. The principal advantage gained over more usual reactor-kinetics methods is the achievement of accuracy with a coarse spatial grid. The principle has been previously established for criticality problems, and is extended to time-dependent problems. The Volterra-integral formulation is then applied to a system of semi-infinite homogeneous slabs. The angular flux is approximated as one speed and isotropic in each angular half space. The surface-to-surface Green's functions are obtained by the application of the method of matched asymptotic expansions to the double-P_0 equations. If the time variation of the cell multiplication is restricted to be slow in comparison with the prompt-neutron lifetime, the response functions may be written in terms of the response of time-independent cells, which greatly reduces the cost of obtaining the response functions. The Volterra equation is solved by an implicit, linear interpolation in time, for ramp changes in cell multiplication. Systems characteristic of both thermal and fast reactors are investigated. Results are compared to those of a zero-prompt-lifetime approximation to the solution of the double-P_0 equations for the entire system. They are found to be in good agreement. The calculations lead to a surmisal that the response-matrix method is capable of providing accurate results with greatly reduced computational effort. Reductions of a factor of 20 and greater in CPU time for the kinetics calculations are observed. The response-matrix method must also be charged with the effort required to compute response functions; thus the full efficiency of the method is only realized if one investigates several problems involving the same cells. (Diss. Abstr. Int., B)

17921 EXPERIMENTAL STUDY OF THE COUPLING BETWEEN TWO CRITICAL REACTORS. Thayer, G. R. Urbana, IL; University of Illinois (1973). 204p. University Microfilms Order No. 74-5715.

Thesis (Ph. D.).

An experimental study has been performed on a coupled-core system consisting of two reactors each of which can be made critical by itself, coupled neutronically by a graphite thermal column. Both steady-state and transient measurements were performed on the system. The steady-state measurement consisted of measuring the coupling coefficient between the two reactors. Also, series of measurements were performed while one of the cores was far subcritical and the coupling between the two cores was varied between 1.6×10^{-2}¢ and 1.6×10^{-3}¢ by the insertion of a water gap and from 1.6×10^{-2}¢ to 6.0×10^{-4}¢ by the insertion of a cadmium sheet between the cores. A one-energy group point-reactor kinetics model was successfully used to describe the behavior of the system. The transient coupling coefficient between the two reactors in this model was described by a constant factor with a time displacement, which was the pulse propagation time through the connecting thermal column. The parameters found from this model agree well with those previously calculated in other studies by Miley and Doshi or those measured in the steady state. Additional models for spatial effects and for a time-dependent coupling coefficient in the transient mode were tested with the data. (Diss. Abstr. Int., B)

17922 MONTE CARLO ANALYSIS OF A GAS CORE REACTOR. Lu, P. K. Columbia, MO; University of Missouri (1973). 179p. University Microfilms Order No. 74-9963.

Thesis (Ph. D.).

A track length estimator Monte Carlo approach has been adopted to the analysis of a gas core reactor; the method easily yields a low variance in a large variety of reactor regions because the neutron flux is recorded for each flight path. In spherical geometry, a uniform statistical error may be obtained in each spatial region and the computation time is reduced if a one-dimensional track length estimator is used in which the track length is replaced by the radial projection of the track length. A one-dimensional, 10-spatial region Monte Carlo calculation was performed in spherical geometry to determine the critical mass, power distribution and 19-group neutron flux distributions in a mockup gas core reactor. The result obtained for K_{eff} was 1.021 compared to an experimental value of 1.02 with an absolute statistical error of about 2% based on 2000 histories. The neutron flux distributions are in excellent agreement with one-dimensional spherical S_4 TDSN calculations. The heat deposition was analyzed as a gamma ray heating problem for a mockup gas core reactor and a heat radiation problem for a hot gas core reactor. A Monte Carlo track length estimator was applied for the gamma ray heating and heat radiation calculation in the propellant region. Diffusion theory and free convection were used for the core and moderator heat deposition studies, respectively. The results showed that the heat deposition is uniformly distributed in the core region and decays exponentially in the propellant and reflector regions for both cases. The results are consistent with previous calculations. (Diss. Abstr. Int., B)

17923 FIRST-FLIGHT COLLISION PROBABILITY IN CYLINDRICAL CELL SYSTEM WITH FINITE HEIGHT. Takeda, T. (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 11: No. 4, 165-168(Apr 1974).

17924 AN EFFECTIVE METHOD FOR CALCULATING THE NEUTRON FIELD IN GEOMETRICALLY COMPLEX LATTICES OF HETEROGENEOUS REACTORS. Smelov, V. V. Sov. J. At. Energy (Engl. Transl.); 33: No. 5, 1061-1062(Nov 1972).

Translated from At. Energ. (USSR); 33: No. 5, 915-916(Nov 1972). This is a summary of paper No. 620/6626 with full copy held at TIC.

The microstructure of the neutron field in the lattice of a heterogeneous reactor must be known in order to calculate the major parameters of the heterogeneous reactor (thermal neutron utilization factor, disadvantage factor, etc.). Calculations of such a field come to constitute a rather complicated problem whenever blocks or slugs of different types are located in the medium. The present article, which puts forth an approximate method for solving the single-velocity transport equation in cylindrical lattices of complex configuration, is devoted to precisely that problem. (auth)

17925 DEVELOPMENT OF AN IBM-1130 ZERO-DIMENSIONAL MULTIGROUP DIFFUSION PROGRAM TO CALCULATE THE NEUTRON SPECTRA AND GROUP CONSTANTS. Cheng, T. C.; Liu, Y. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 8: No. 3-4, 1-10(Dec 1971).

A FORTRAN IV zero-dimensional multigroup diffusion program MUGP is developed for the IBM-1130 computer. Based on the method of the original program MUPO, it solves the point diffusion equations in 43 energy groups. Having obtained the neutron spectrum, the program proceeds to calculate the condensed absorption, fission, neutron production and scattering microscopic cross sections for all isotopes specified. The condensed few group constants can be punched on cards which can be directly used by other diffusion or burnup programs. 3 references. (auth)

17926 RESONANCE ABSORPTION OF NEUTRONS IN TUBULAR FUEL ELEMENTS. Orlov, V. V.; Sharapov, V. N.; Vaimugin, A. A.; Galanin, A. N.; Kisil, I. M. At. Energ. (USSR); 36: No. 6, 491-496(Jun 1974). (In Russian).

A method of calculating the ^{238}U effective resonance integral for a tubular-element bundle is described. The calculations were carried out taking into account the shielding of each fuel element by all the others and the shielding of the inner surface of the fuel element. On the basis of the effective resonance integral obtained in this manner, the resonance escape probability for neutrons (φ) has been calculated. Satisfactory agreement between the coefficient φ calculated in this manner and measured values is demonstrated using reactor data from the Obninsk, Beloyarsk and Bilibino atomic power stations. (auth)

17927 DEVELOPMENT OF METHODS OF PHYSICAL CALCULATION OF REACTORS FROM THE WORLD'S FIRST ATOMIC POWER STATION TO THE PRESENT TIME. Akimov, I. S.; Minashin, M. E.; Sharapov, V. N. At. Energ. (USSR); 36: No. 6, 427-431(Jun 1974). (In Russian).

A method of calculating reactor power distributions based on the solution of two-dimensional, two-group neutron diffusion equations is outlined. Elaborated codes permit taking into account an arbitrary arrangement of fuel channels, control rods, voids, etc. A comparison of calculations with experimental results obtained from the Beloyarsk Atomic Power Station demonstrates that channel-to-channel power distribution calculations are accurate to within about 5%. (auth)

Reactor Components and Accessories

Refer also to abstracts 15271, 15283, 15298, 15342, 15344, 16239, 16243, 16316, 16317, 16353, 16390, 16394, 16441, 16442, 16460, 17302, 17491, 17495, 17502, 17503, and 17868.

17928 (AED-CONF-74-6-5) MECHANICAL BEHAVIOR OF STRUCTURAL REACTOR COMPONENTS. Purposes and Possibilities of Numerical Analyses. Brandes, K. (Bundesanstalt fuer Materialpruefung, Berlin (F.R. Germany)). 1974. 18p. (In German). INIS.

From experts meeting of the task groups "thermodynamics and fluid dynamics" and "reactor physics" of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactor; Karlsruhe, F.R. Germany (29 Jan 1974).

The analysis of the mechanical behavior of reactor components and the design of structural reactor components, based on appropriate experience in this field, is an integral part of reactor engineering. One of the main purposes of this field is to describe and analyze the various stresses and deformations affecting the reactor components during their serviceable life. (INIS)

17929 (ANL-CT-74-5) ANNOTATED BIBLIOGRAPHY ON FLOW INDUCED VIBRATIONS. Mulcahy, T. M.; Chen, S. S. (Argonne National Lab., Ill. (USA)). Jan 1974. Contract W-31-109-Eng-38. 127p. Dep. NTIS $5.45.

This collection of references and annotations on flow-induced vibrations was compiled as part of the process of determining available information which could be useful in the prediction of the flow-induced vibrations of the internal components of reactors. Particular emphasis was given to surveying analytical prediction methods and results, experimental data and methods, as well as scale modeling practices, procedures, and results. (auth)

17930 (CONF-721018-(Vol.1)) PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON REACTOR SHIELDING, PARIS, FRANCE, OCTOBER 9-13, 1972. Volume 1. (Organization for Economic Co-Operation and Development, 75-Paris (France); CEA, 75-Paris (France)). 1972. 233p. (In several languages).

Separate abstracts are included for each of the 13 papers presented concerning reactor shield design, design criteria and philosophy for radiation shielding, and dissemination of shielding information. (DCC)

For abstracts of individual papers see: 17489, 17490, 17569, 17633, 17676-17681, and 17786-17788.

17931 (CONF-721018-(Vol.2), pp 370-395) NEW MODIFICATIONS OF THE MONTE CARLO METHOD FOR USE IN CALCULATING DIFFERENTIAL CHARACTERISTICS OF THE GAMMA RAY FIELD OUTSIDE REACTOR SHIELDING. Viktorov, A. A.; Zolutukhin, V. G.; Klimanov, V. A.; Kochanov, V. A.; Ksenofontov, A. I.; Mashkovich, V. P.; Orlov, N. Yu.; Panchenko, A. M.; Sinev, V. N. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The characteristics are studied of the gamma ray field created by plane sources with energies ranging from 0.145 to 7.0 MeV outside uniform and non-uniform slabs (barriers). Modifications of Monte Carlo calculations, such as the minimum variance method, a variant of the exponential transformation technique, and the parametric method are presented, which, when applied with a computer, make it possible to calculate radiation fields over large thicknesses and in shielding containing irregularities. 14 references. (auth)

17932 (CONF-721018-(Vol.2), pp 409-433) USE OF MODULAR CODES IN A UNIFIED SCHEME OF SHIELD DESIGN PROCEDURES FOR COMMERCIAL REACTOR PLANT. Miller, P. C. (Atomic Energy Establishment, Winfrith, Eng.); Grimstone, M. J.; Packwood, A.; Dawson, J. K.; Pugh, I. G. 1972.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The arguments leading to the development of a new suite of modular codes for the design of commercial reactor shields are outlined. The modular system facilitates the construction of large codes, and the linking of stand-alone codes in the multi-stage hybrid calculations which are of central importance in modern commercial shielding practice. Two levels of approximation have been adopted: quick and relatively accurate codes based on diffusion, albedo and kernel methods are used for survey studies and shield optimization; while definitive calculations for marginal situations and final performance assessments may be accomplished with Monte Carlo methods. The physical models used in these multi-stage calculations have a strong experimental basis involving measurements on zero-energy reactors to determine source spectra and penetration experiments on individual shield features simulated in the fission plate facilities on NESTOR. However, it is the measurements made on operational plant which provide the ultimate test of the overall accuracy, and permit the study of those aspects of the design which cannot be simulated adequately in the laboratory. The capabilities of this comprehensive range of design tools are illustrated with reference to measurements made on operational power reactors including the WAGR, the SGHWR and the concrete vessel plant at Oldbury. 7 references. (auth)

17933 (CONF-721018-(Vol. 3)) PROCEEDINGS OF THE FOURTH INTERNATIONAL CONFERENCE ON REACTOR SHIELDING, PARIS, FRANCE, OCTOBER 9-13, 1972. Volume 3. (Organization for Economic Co-Operation and Development, 75 - Paris (France); CEA, 75 - Paris (France)). 1972. 564p. (In several languages).

Separate abstracts are included for each of the 30 papers presented concerning engineering solutions to shielding problems, problems related to reactor plant operation, and test of design methods. (DCC)

For abstracts of individual papers see: 15366, 15640, 17302, 17500-17504, 17570-17572, 17600-17602, 17634-17640, 17668, 17683-17687, 17745, 17934, and 17935.

17934 (CONF-721018-(Vol. 3), pp 682-701) PARTICULAR PROPERTIES OF PROTECTION CONCRETE AFFECTING RADIATION ATTENUATION PROCESSES. Dubois, F. (CEN de Saclay, Gif-sur-Yvette, France). 1972. (In French).

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

The use of concrete as shielding material in nuclear reactors has shown that a better knowledge of its nature could improve results of radiation attenuation calculation. Hydrogen and some absorbant materials of slight importance as well as the knowledge of the evolution of water contents in hydraulic binders and aggregates play a preponderant part in the choice of concretes. Studies made by C.E.A. of the different kinds of special shielding concrete as a function of temperature, concrete thickness, its mineralogical composition, favor the wide use of these materials in reactor shielding. (14 references) (auth)

17935 (CONF-721018-(Vol. 3), pp 717-730) STREAMING OF NEUTRONS AND GAMMA-RAYS ALONG REACTOR COOLANT PIPES. Amin, E.; Hehn, G.; Zumach, W. (Univ., Stuttgart). 1972.

From fourth international conference on reactor shielding; Paris, France (9 Oct 1972).

A systematic investigation has been conducted to determine the streaming effect of neutrons and gamma rays along straight reactor coolant pipes. Different dimensions, as well as a variety of coolant materials, have been considered, like water, steam, and sodium. The standard material configuration consists of four material zones representing the coolant, the pipes wall, the thermal isolation embedded in the bulk shield. It was found that a large contribution of the total streaming effect is due to the thermal insulation zone which could be reduced by using additional absorber. (7 references) (auth)

17936 (IAEA-PL-504-5) SPANISH CONTRIBUTION TO THE GROUP OF EXPERTS ON EXPERIENCES AND METHODS FOR THE REPAIR OF REACTOR COMPONENTS. Alvarez de Buergo, L.; Gil Enciso, R.; Herranz de Miguel, R. (International Atomic Energy Agency, Vienna (Austria)). 1972. 18p. (In Spanish). INIS.

Operating experience in relation to necessary repairs at the three Spanish Nuclear Power Stations José Cabrera (Zorita-1), Santa Maria de Garoña, and Vandellos is presented. All three stations have experienced minor difficulties during operation, and for each abnormality, a description of the abnormal operation, the study to determine the cause, and the method of repairing the component are given in detail. Problems encountered have been various kinds of leaks in valves, piping, etc.; leaks in pumps due to corrosion and degradation of various seals. Distortion of some baffles in a fuel assembly due to mechanical vibrations caused by fluid flow, and the loss of a piece of metal inside the reactor core from a fuel charging machine presented special difficulties. (INIS)

17937 (IAEA-PL-504-7) EXPERIENCE AND TECHNIQUES ON THE MAINTENANCE OF NUCLEAR POWER PLANTS IN JAPAN. Suguri, S. (International Atomic Energy Agency, Vienna (Austria)). 1972. 34p. INIS.

Six nuclear power stations have been in operation in Japan. The first electricity generation in Japan was achieved by Japan Power Demonstration Reactor (JPDR) of Japan Atomic Energy Research Institute in October 1963, and the first commercial power plant in Japan is Tokai Nuclear Power Station of Japan Atomic Power Co., whose first electricity generation was achieved in November 1965. The others are Tsuruga Nuclear Power Station, Fukushima Nuclear Power Station No. 1, Mihama Nuclear Power Station No. 1 and No. 2, which were in operation in 1970. The general features of the plants are shown. Since JPDR and Tokai Nuclear Power Station have been operated for a long time, several problems have been experienced during the period, some of which are described. The other four stations have also gained experience in maintenance since their operation. This experience is also reflected. (INIS)

17938 (INIS-mf-1322) TRANSIENTS IN COOLING WATER SYSTEMS OF THERMAL POWER PLANTS. Safwat, H. H. (Technische Hogeschool Delft (Netherlands)). 27 Jun 1972. 144p. INIS.

Thesis.

Transient conditions in the cooling water systems of thermal power plants, which result from pump trip-out, are examined. The nature of the resulting hydraulic transients as regards water hammer and water column separation is discussed. The need for a dependable means of predicting resulting pressure changes in the design of modern power plants is pointed out. The simulation of a typical cooling water system for experimental study of such transient conditions is discussed. The study was carried out in three phases: transients in a horizontal line, in a syphon, and in a syphon with a condenser model at its highest point. The simulation of the conditions resulting from a pump failure by closing a specially-built valve is included. Flow measurements were made to obtain friction factors for steady flow in the pipe and valve resistance. Two methods were adopted for the measurement of transient velocity changes for hydraulic transients. The first was a photographic method while the second used a specially-built induction flowmeter. The measured strains were used together with transient pressure measurements to evaluate the elastic behavior of the pipe wall during such hydraulic transient conditions. A comparison of the measurements with the calculated results showed a number of discrepancies. This comparison together with the photographic study of water column separation formed the basis for proposing a new mathematical model to describe flow conditions for a one-dimensional non-steady flow with the resulting pressure near the vapor pressure. The role of the cavitation bubbles occurring during the transients along the pipe length in the momentum loss and in the celerity decrease is emphasized. Numerical calculations based on the new mathematical model were used to simulate pressure and velocity changes under different test conditions. (INIS)

17939 CONSIDERATIONS FOR TOTAL NUCLEAR PLANT DECONTAMINATION. Saltarelli, E. A. (NUS Corp., Rockville, MD). Trans. Amer. Nucl. Soc.; 18: 77(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17940 DESIGN OF IN-PLANT CALIBRATION FACILITIES. Nestel, W. A. (Commonwealth Edison Co., Zion, IL); Schwab, G. V.; Determan, W. R.; Foreman, D. L. Trans. Amer. Nucl. Soc.; 18: 357-358(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17941 PROTECTION-SYSTEM DEVELOPMENTS AND TRENDS IN THE FEDERAL REPUBLIC OF GERMANY. Schallopp, B. (Technische Hochschule, Stuttgart). Nucl. Safety; 15: No. 4, 409-417(1974).

Some of the basic ideas and philosophies applied to reactor-protection systems in the Federal Republic of Germany are reviewed. Reviewed are the implementation and application of designs for the self-monitoring of electronic systems and for the use of computers in the protection systems of existing nuclear power stations. (27 references) (auth)

17942 STATUS REPORT ON COMPUTATIONAL TECHNIQUES FOR FINITE ELEMENT ANALYSES. Melosh, R. J. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Nucl. Eng. Des.; 27: No. 2, 274-285(1974).

Fifteen years of research, development, and application of the finite element concept, primarily to structural analysis, has yielded a host of techniques for computer implementation. The importance of using these techniques is shown by an estimated reduction in total computer costs by a factor of 20. The techniques which play an important role in currently available computer software are described, and research work in the engineering literature which can be expected to stimulate development of new techniques in the next decade is indicated. The thrust for better techniques will be provided by the expanding need for software in newer applications such as nuclear fusion, fracture mechanics, bioengineering simulations, and vehicle crashes. New techniques will yield computer software which more highly automates finite element use, will more efficiently solve large sets of equations, and which will be more universally applicable. (auth)

17943 LARGE USER-ORIENTATED SYSTEMS OF PROGRAMS FOR STRUCTURAL ANALYSIS AND DESIGN. Jaznik, A.; Miller, M. C. (Central Electricity Generating Board, London). Nucl. Eng. Des.; 27: No. 2, 238-273(1974).

A modular system of structural analysis packages is described. The principal motivation in developing the system is to rationalize and simplify the considerable diversification of applications and techniques currently available. The applications encompass elastic, thermal, dynamic, creep and plastic analyses of arbitrary two-dimensional and three-dimensional structures. The system uses a standardized form of input for all applications and provides user-aids such as mesh generation, error facilities, output facilities (on-line and graphical) as integrated system modules. Calculational packages at present integrated into the system comprise FLHE-BERSAFE (thermal and elastic, two and three dimensions), TESS (Creep and plasticity, two dimensions), and STAG21 (visco-elastic, two dimensions) codes. Various element types and a comprehensive selection of different solution techniques based mainly on finite element displacement model can be used in the analyses. All data presented to the system are in the form of files (datalists) stored on magnetic disks. A comprehensive permanent disk library containing thermal and mechanical properties of the most commonly used materials is available to all users. The system is designed to be "open-ended" in the sense that new subsystems can be augmented easily. It is envisaged that these additions will include structural analysis

applications which are strictly outside the area of finite element analysis, e.g., frameworks. The internal structure and mode of operation of the system are described in detail. Several diverse examples of nuclear design problems which have been studied are given. An examination and comparison with other large structural analysis systems currently available are given, together with a discussion of possible future developments in this field. (auth)

17944 SPARE PARTS RESERVATION OF COMPONENTS SUBJECTED TO WEAR-OUT AND/OR FATIGUE ACCORDING TO A WEIBULL DISTRIBUTION. Birolini, A. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Eng. Des.; 27: No. 2, 293-298(1974).

The determination of the number n of spare parts necessary to cover with probability ≥W replacement requirements during the time interval (0,T] for the case where only a single part is used at a time is discussed. It is assumed that the lifespan of the parts is distributed according to a Weibull distribution with shape parameter $\beta \geq 1$. For small values of n, $1 \leq n \leq 10$, charts of n = n (T/MTTF, W, β) are given for W = 0.99, 0.95, 0.9, 0.75 and β = 1, 1.2, 1.5, 2, 3, 4 (MTTF is the mean of the lifespans). For large values of n, an asymptotic approximation is derived from the central limit theorem. An important result of this study is to show that the asymptotic formula obtained—which, irrespective of the exact form of the distribution function of the lifespan depends on the coefficient of variation σ/MTTF only—gives good approximations for relatively small values of n. In fact, for $n \geq 10$ and $\beta \geq 1$, the error is <±1 spare part for $5\% \leq W \leq 95\%$ and <±2.2 spare parts for $1\% \leq W \leq 99\%$. The widespread application of the Weibull distribution (for example to approximate the distribution of the lifespans of electronic and mechanical parts subjected to wear-out and/or fatigue) is then briefly discussed. (auth)

17945 TOWARDS SELF-RELIANCE IN NUCLEAR POWER SRINIVASAN, M. R. Nucl. India; Republic Day Special: 18-22 (26 Jan 1974).

The development of nuclear technology and reactor production capabilities in India is discussed. (DG)

17946 FATIGUE OF CYLINDERS SUBJECTED TO REPEATED PRESSURE. Sakata, M. (Tokyo Inst. of Tech.); Kai, T.; Otobe, H.; Nagata, K. Koatsu Gasu; 10: No. 2, 75-83(Apr 1973). (In Japanese).

Experiments were conducted on the fatigue strength of cylinders subjected to repeated pressure in order to obtain information for the design of pressure vessels. Materials tested were corrosion-resistant aluminum alloy A2B2, aluminum A1B1, stainless steel SUS 32, and carbon steel S48C. Macroscopic features of fatigue fracture were observed, and fractured faces were examined by fractographs. (1) In the thin-walled cylinders of A2B2, SUS32, and S48C, where both ends were either closed or open, intermediate principal stress had no influence on the fatigue strength. (2) In both thin and thick-walled cylinders of A1B1 and A2B2 with both ends closed, the fatigue strength can be better treated through maximum principal stress rather than maximum shear stress. (3) In the self-squeezed cylinder of A2B2 with both ends closed, the time fatigue strength increased by this process, except at low pressure, where the effect was hardly seen. (JA)

17947 DYNAMICAL BEHAVIOR OF COILED SPRINGS. Suzuki, S. (Nagoya Univ., Japan). Kikai No Kenkyu; 25: No. 8, 1022-1026(Aug 1973). (In Japanese).

In nuclear reactors, control rods must be dropped into the reactor core if power density becomes excessive. If and when the control rods strike against the grid plate of the reactor core, very large dynamical stresses may be induced in the grid plate. In order to evaluate these stresses, the dynamical behavior of the grid plate was studied by assuming that the grid plate was a circular plate with a concentric opening whose outer rim was fixed and inner rim was free. As a result, it was pointed out that extremely high shock stress might occur and the circular plate might be broken down. In order to reduce this shock stress, a spring was attached to an inertial mass. This system showed fairly good damping effect. The dynamical behavior of a coiled spring with a concentric mass at the spring head was investigated when a rigid object strikes against the coiled spring. By resolving the basic equation of vibration, the deflection and force at a fixed point of the spring were determined, and they were compared with experimental values. As a result, when the rigid object strikes the spring, the force at the fixed point of a spring has two extreme values at two different times. The dynamic load factor decreases rapidly initially and after that diminishes gradually, as solid viscosity increases. (JA)

17948 IRRADIATION TEST RELUCTANCE TYPE PRESSURE SENSOR FOR MEASURING FISSION GAS PRESSURE. Tanaka, I.; Onodera, K. (Japan Atomic Energy Research Inst., Oarai). J. Nucl. Sci. Technol. (Tokyo); 11: No. 3, 104-109(Mar 1974).

A reluctance type pressure sensor for continuous measurements of the fission gas pressure in fuel pins during irradiation was developed and irradiated in the JMTR. The pressure sensor is constituted of magnetic materials and electrical conductors, which may be affected by heat and radiation, and this in turn may impair the accuracy of the instrument. An irradiation test was performed to obtain quantitative information on the accuracy of the pressure sensor itself and for examining its viability in actual use under radiation. The test was made during three cycles of operation of the JMTR at 30 MW reactor power. The calculated neutron fluence was about 4.2×10^{19} n/cm^2 (E > 1.05 MeV) and 6.8×10^{20} n/cm^2 (E < 1.05 MeV). It was found that the effect of heat was larger than that of radiation from a fluence of this order, but the former effect can be reduced by correction for temperature. The error due to radiation effect is estimated to be about ±1.0% at the limiting pressure of 50 kg/cm^2 G. The error at full power (30 MW), including the ±1.0% given above for the radiation effect, as well as other errors such as that of the pressure sensor itself and the temperature effect remaining after correction, is estimated to be about ±1.8% at the limiting pressure of 50 kg/cm^2 G when the neutron fluence does not exceed the values indicated above. In actual measurements of the fission gas pressures in fuel pins, the total error including those inherent in the apparatus for measuring the back pressure, is expected to be about ±2.8%. Practical application of the pressure sensor has been proved to be promising as a result of the irradiation test. (auth)

Reactor Fuels

Refer also to abstracts 15017, 15071, 15072, 15090, 15091, 15345, 15514, 16140, 16141, 16144, 16178, 16181, 16190—16203, 16259, 16266, 16267, 16350—16352, and 16437.

17949 (INIS-mf-975) EXPERIMENTS ON FABRICATION OF FUEL ELEMENTS FOR FAST REACTORS. Dalmastri, B.; Fizzotti, C.; Nenci, F. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Oct 1972. 6p. INIS.

From second Italian—Polish meeting on some chemical, ceramic, and metallurgic aspects of nuclear fuels; Rome, Italy (3 Oct 1972).

Investigations on fabrication of fuel elements for fast reactors were performed at CNEN. Several components, a few prototype fuel elements, and pins for irradiation experiments have been fabricated. Several experiments to evaluate other fabrication techniques and to test the fabricated components were carried out. Thermal treatments were performed on the fabricated components and induced distortions were detected. Some of these tests have already been performed with available equipments; other tests, for instance those concerning the thermal cycling of a full scale element, require special machines that are now under construction. (INIS)

17950 FUEL CYCLE STAFFING AND RESEARCH REQUIREMENTS: UTILITY VIEW. Mullin, R. J.; Ratliff, J. R. (Tennessee Valley Authority, Knoxville). Trans. Amer. Nucl. Soc.; 18: 35(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, Pennsylvania (23 Jun 1974).

17951 ACADEMIC RESEARCH ON THE FUEL CYCLE. Dahlberg, R. C.; Turner, R. F. (General Atomic Co., San Diego, CA). Trans. Amer. Nucl. Soc.; 18: 35-36(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17952 ACADEMIC RESEARCH ON THE FUEL CYCLE. Tulenko, J. S. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 18: 36-37(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17953 SUCCESSFUL INDUSTRY/ACADEMIC RESEARCH: CASE STUDY. Mason, E. A. (Massachusetts Inst. of Techn., Cambridge). Trans. Amer. Nucl. Soc.; 18: 37-38(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17954 INFLUENCE OF FUEL MICROSTRUCTURE ON IN-PILE DENSIFICATION. Chubb, W.; Hott, A. C.; Argall, B. M.; Kilp, G. R. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 120-121(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17955 EEI FUEL DENSIFICATION PROGRAM. Freshley, M. D.; Goldsmith, S. (Battelle-Pacific Northwest Labs., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 122(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17956 EFFECT OF FUEL DENSIFICATION AND RELOCATION ON THERMAL PERFORMANCE. Proebstle, R. A.; Elkins, R. B.; Marlowe, M. O.; Johannson, E. B.; Potts, G. A.; Stijovic, R.; Rowland, T. C. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 121-122(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17957 IN-PILE DENSIFICATION CHARACTERISTICS OF URANIUM DIOXIDE. Yario, W. R.; Ziegler, S. T.; Hollowell, T. E.; Harkness, S. D.; Andrews, M. G.; Duncan, R. N. (Combustion Engineering Co., Windsor, CT). Trans. Amer. Nucl. Soc.; 18: 123(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17958 CALCULATION OF QUASISTATIC ELASTIC-PLASTIC DEFORMATION WITH HEAT CONDUCTION. Reaugh, J. E. (Physics International Co., San Lenadro, CA). Trans. Amer. Nucl. Soc.; 18: 135-136(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17959 NEW METHOD FOR CALCULATING SPACE-DEPENDENT BURNUP. Sekimoto, H.; Pigford, T. H. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 18: 137-138 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17960 NEW METHOD FOR OPTIMIZING IN-CORE FUEL MANAGEMENT. Sekimoto, H.; Pigford, T. H. (Univ. of California, Berkeley). Trans. Amer. Nucl. Soc.; 18: 140-141 (Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17961 PREDICTING THE REACTIVITY EFFECTS OF ^{241}Pu IN MIXED-OXIDE LATTICES. Artigas, R. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 166-167(Jun 1974).
From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17962 PLUTONIUM SEGREGATION IN MIXED OXIDE FUEL PINS WITH CENTER MELTING. Geithoff, D. (Kernforschungszentrum, Karlsruhe, Ger.). pp 39-56 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974).
From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol. 1); CONF-730726-P1.
Extensive segregation of plutonium from uranium was observed in a number of mixed-oxide fuel pins (85% UO_2, 15% PuO_2) irradiated in sodium-filled capsules in the reactor FR 2 at Karlsruhe. The maximum burnups achieved in this experiment came close to 8% fima. Alpha-autoradiography on longitudinal and transverse cross sections revealed that certain areas consisted of almost pure uranium oxide with very little plutonium left, while in other axial positions of the same pins the missing plutonium was located in the form of strongly enriched zones. The plutonium-depleted zones were found both in the central region of the pin and in the fuel periphery adjacent to the cladding. In some cases this material formed a plug completely blocking the central void. Evidence that center melting had occurred in the course of irradiation was obtained by ceramography and x-ray inspection using a betatron. In previous experiments with the same fuel, short-term melting had never produced such extensive fuel segregation. So it is concluded that keeping the fuel in a molten state for a long time and slow cooling are the prerequisites for the observed effects. On the basis of the UO_2/PuO_2 phase diagrams, an explanation for the segregation is offered. (14 figures) (auth)

17963 INVESTIGATION OF REACTION BETWEEN OXIDE AND CLADDING IN THE G5 EXPERIMENT AT HIGH BURN-UP. Conte, M.; de Keroulas, F.; Mikailoff, H.; Dieumegard, M. (CEN, Fontenay-aux-Roses, France). pp 197-220 of Fuel and Fuel Elements for Fast Reactors. Vol. I. Vienna; International Atomic Energy Agency (1974). (In French).
From symposium on fuel and fuel elements for fast reactors; Brussels, Belgium (2 Jul 1973). See STI/PUB-346(Vol.1); CONF-730726-P1.
A mixed-oxide fuel element $(U_{0.8},Pu_{0.2})O_{1.97}$ clad in 316 steel was irradiated at 125,000 MWd/t with the cladding temperatures ranging from 530 to 750°C. Micrographic analysis revealed the presence of a reaction zone at the interface between the oxide and the cladding as well as intergranular corrosion of the cladding. A relationship was established between the morphology and the depth of the perturbed zones and the cladding temperature. By x-ray analysis performed with the aid of an electron microprobe, the nature of the different layers examined and the amounts of their main constituents were able to be determined. (20 figures) (auth)

Reactor Control Systems

Refer also to abstract 17804.

17964 (AED-CONF-74-6-20) INSTRUMENTATION AND CONTROL OF THE DYNAMIC BEHAVIOR OF POWER REACTORS. Schruefer, E. (Kraftwerk Union A. G., Frankfurt am Main (F.R. Germany)). 1974. 14p. (In German). INIS.
From experts meeting of the task groups "thermodynamics and fluid dynamics" and "reactor physics" of the KTG on requirements and present possibilities of predicting physics parameters of thermal and fast power reactor; Karlsruhe, F.R. Germany (29 Jan 1974).
The instrumentation of a power reactor is considered with regard to the rate at which measuring instruments can follow a change in the variable to be measured. After a definition of the transition function and the frequency response curve, the time behavior of different measuring transducers is investigated. (INIS)

17965 (HEDL-TME-74-20) FTR EUROPIA HEATING RATES. Kidman, R. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1974. Contract AT(45-1)-2170. 73p. Dep. NTIS $5.45.
Europium oxide is being investigated as a possible neutron absorber material for use in FTR and LMFBR control rods. The calculations performed to obtain detailed europia heating rate distributions for fully inserted row 5 and row 7 FTR control rods are presented. The maximum europia heating rates for axially averaged slabs in the row 5 and row 7 control rods were calculated to be 10.3 w/gm and 6.4 w/g, respectively. In a row 5 control rod, the maximum heating rate occurs near the center of the rod and tapers off to minimum along the edge. In a peripheral (row 7) control rod, the maximum heating rate occurs at the edge of the rod adjacent to the core and tapers off to a minimum along the outer edge. The ratio of maximum heating rate to minimum heating rate was ~1.3 for the row 5 control rod and ~1.7 for the row 7 control rod. These heating rate and ratio predictions are required for proper design of experimental europia control rod subassemblies. 33 references. (auth)

17966 (HEDL-TME-74-22) DRIVELINE DASHPOT TEST, WDTRS 3.04. Defferding, L. J.; Fiskum, O. S. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1974. Contract AT(45-1)-2170. 37p. AT.
Water tests were run to determine the performance characteristics of the FFTF control rod dashpot. The tests provided data to permit final adjustment of the ARD computer program that was used to predict dashpot performance. (auth)

17967 (MRR-131) CONCEPTS OF DIGITAL CONTROL IN REACTOR TECHNOLOGY. Beraha, D. (Technische Univ. Muenchen, Garching (F.R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Oct 1973. 94p. (In German). INIS.
2 figs.; 90 refs. with abstract in German and English.
After a short introduction to the main ideas and methods of modern control theory a survey of important papers on the subject of modern reactor control is given. These new developments are then discussed in the light of reactor safety. (GE)

17968 (N-73-32533) MOVABLE-MOLYBDENUM-REFLECTOR REACTIVITY EXPERIMENTS FOR CONTROL STUDIES OF COMPACT SPACE POWER REACTOR CONCEPTS. Fox, T. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Oct 1973. 26p. (NASA-TM-X-2922; E-7514). NTIS $3.00.
An experimental reflector reactivity study was made with a compact cylindrical reactor using a uranyl fluoride–water fuel solution. The reactor was axially unreflected and radially reflected with segments of molybdenum. The reflector segments were displaced incrementally in both the axial and radial dimensions, and the shutdown of each configuration was measured by using the pulsed-neutron source technique. The reactivity effects for axial and radial displacement of reflector segments are tabulated separately and compared. The experiments provide data for control-system studies of compact-space-power-reactor concepts. (auth)

17969 HIGH-FLUENCE EBR-II DUCT SWELLING AND MECHANICAL PROPERTY REVIEW. Fish, R. L. (Westinghouse-Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 106-107(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17970 CONTROL AND INSTRUMENTATION TESTING AT FORT ST. VRAIN. Block, G. A.; Kolaczkowski, A. M.; McCue, D. E.; Netzel, L. J. (General Atomic Co., Platteville, CO). Trans. Amer. Nucl. Soc.; 18: 259-260(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17971 LMFBR CONTROL RODS SCRAM DYNAMICS. Carelli, M. D.; Brandt, H. W.; Bach, C. W.; Kulikowski, H. D. (Westinghouse Electric Corp., Madison, PA). Trans. Amer. Nucl. Soc.; 18: 278-279(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17972 LIMITED CONTROL LANGUAGE FOR DIRECT DIGITAL CONTROL. Welbourne, D. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). pp 1-8 of Software for Control. London; Institution of Electrical Engineers (1973).

From conference on software for control; Warwick, England (17 Jul 1973).

The nuclear power industry has moved from the data loggers needed for thermocouple monitoring, through extensive data processing systems such as that at Wylfa, and now involves full integration of the normal power control and start-up control into the computing system scope. Hartlepool power station, and the replicate station at Heysham involve extensive computer systems. The method of implementation of the control facilities is described. (auth)

17973 COMPUTER DEVELOPMENTS FOLLOW CANADA'S NUCLEAR PROGRAMME. Koekebakker, J. (Ontario Hydro's Pickering Station, Toronto). Energy Int.; 11: No. 6, 17-20(Jun 1974).

Computer control systems being built for the Bruce generating station are described. Innovations and refinements of the earlier system designed for the Pickering station are listed. (DG)

17974 ONE MAN CONTROL DESK FOR NUCLEAR POWER PLANT. Johnson, R. E. (General Electric Co., San Jose, CA). Energy Int.; 11: No. 6, 11-13(Jun 1974).

A control room desk for a BWR system which utilizes advanced electronic design concepts and component packaging techniques is described. (DG)

17975 DIRECT DIGITAL CONTROL AT BRUCE NUCLEAR GENERATING STATIONS. Koekebakker, J. Can. Contr. Instrum.; 13: No. 4, 15-18(Apr 1974).

The control system at Bruce generating station represents significant rethinking of the designs implemented at the Pickering generating station. Bruce has four generating units of 750 MW each. Each unit is served by a master and an operating standby computer system. The conventional control panel layout has been done away with. In its place, for each unit, are ten crt displays driven by two display controllers. Control room staff have greater selectivity of what information is displayed at any given moment. Hardware advances have allowed Bruce to obtain better performance from completely solid-state process input-output at a lower cost than was paid for the Pickering system. The software approach has been to keep control programs largely separated so that control is transferred from computer to computer on an individual function basis. No control function is abandoned without a repeat of the function. (CA)

17976 CONTROL SYSTEM OF NUCLEAR REACTOR. Kanemitsu, T. (Yokogawa Electric Works, Ltd., Musashino, Japan). Yokogawa Giho; 17: No. 3, 158-164(Nov 1973). (In Japanese).

The principles of operation and control of nuclear reactors are described. Though the output of reactors is represented generally by thermal output, which is obtained from the measurement of temperature rise and flow rate of coolant in the reactors, it is too slow to permit control of reactors, so the monitoring of neutron flux, especially at low output stage, is required. For this purpose, neutron detectors such as BF_3 proportional counters and ionization chambers are employed. In nuclear power stations, process instrumentation and control are also required. For example, the main control system in PWR power plants is composed of control systems for reactor output, pressurizer, feed water, and steam dumping. Considering reliability, operational accuracy, and speed, it is desirable that these systems are of multiple operational modular construction, and mere collection of universal process controllers will not suffice. It is also necessary that process control instruments are strictly quality-controlled to the extent that requires considerable change of manufacturers' quality control systems. (JA)

Nuclear Power Plant Economics

Refer also to abstract 15868.

17977 (UCID-16536) UNDERGROUNDING OF NUCLEAR REACTORS BY OPEN PIT EXCAVATION. Wooster, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Feb 1974. Contract W-7405-Eng-48. 5p. Dep. NTIS $4.00.

Cost estimates are made for an open pit excavation designed to permit underground placement of the primary reactor circuits of a commercial nuclear power plant at a depth of 400 ft. (DG)

17978 ENERGY MODELS WITH SOCIETAL COMPONENTS. Wyman, M. E. (Univ. of Illinois, Urbana). Trans. Amer. Nucl. Soc.; 18: 39(Jun 1974).

From annual meeting of American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17979 LIMITS OF NUCLEAR POWER PENETRATION IN UTILITY SYSTEMS. Kaupang, B. M.; Marsh, W. D. (General Electric Co., Schenectady, NY). Trans. Amer. Nucl. Soc.; 18: 171-172(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17980 APPLICATION OF MID-RANGE PLANNING METHODS TO NUCLEAR SYSTEMS. Bennett, L. L. (Oak Ridge National Lab., TN); Farrar, D. L. Trans. Amer. Nucl. Soc.; 18: 174-175 (Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17981 NUCLEAR ENERGY IN ISRAEL. Yiftah, S. (Soreq Nuclear Research Centre, Yavne, Israel). pp 457-463 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The introduction of nuclear energy to Israel can be described as a progression of three stages: the search for nuclear materials, the building and operation of research reactors and the building and operation of nuclear power stations. A first report on "Nuclear Power Stations in Israel" was presented to the Government in 1962. From 1964, dual-purpose nuclear plants, for power production and water desalination, were studied. Presently, at the beginning of 1973, Israel is entering the third stage, namely the stage of building and operating nuclear power stations. A first order of a 400-500 MW(e) power reactor is awaiting a governmental decision. In view of the six to seven years doubling time of electric generating capacity in Israel, it is likely that the total network of more than 3000 MW(e) in 1980 will rise, even if the doubling time were to increase, to more than 8000 MW(e) by 1990 and perhaps 18-20,000 MW(e) by the year 2000. Of the 15-17,000 MW(e) generating capacity to be built and operated between 1980-2000 it is anticipated that about half will be nuclear. This means that the nuclear power program in Israel for this period includes about 8-10 nuclear power stations. The first phase may consist of about four thermal power reactors in the 500-800 MW(e) range of either the BWR-PWR enriched uranium or the HWN natural uranium varieties. From about the middle of the 1980's a second phase of about four fast power reactors in the 1000 MW(e) range can be envisaged. These ten big potential "radiation sources" in a small country like Israel are and will be studied carefully in all aspects, including radiation protection. (auth)

17982 INTEGRATION OF NUCLEAR POWER INTO THE GREEK SYSTEM. Stelakatos, C.; Karangelos, J. (Public Power Corp., Athens, Greece). pp 464-481 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The Greek electrical energy policy and the problems therefrom are considered. This policy is primarily based on an intensive development and utilization of the domestic energy resources (lignite deposits and hydraulic potential). An account is given of the stand of the Public Power Corporation as to the use of nuclear power as well as a brief description of the legislation in force or due to be introduced in relation to the licensing of nuclear power stations, and the policy adopted on matters affecting site selection. The views of the Corporation are set forth on current development in the field of nuclear technology, particularly as to the selection

of the reactor type and size as per the requirements of the Greek system. A description of environmental aspects indicates that they constitute one of the serious problems for the introduction of nuclear energy in a country. 6 references. (auth)

17983 NUCLEAR PLANT LEAD TIME, COSTS, LABOR, AND MATERIAL TAKEOFFS. Budwani, R. (United Engineers and Constructors, Inc., Philadelphia). Power Eng.; 78: No. 4, 60-63 (Apr 1974).

Manpower and material breakdowns were derived from masses of data provided by 36 utilities, two engineer/constructors, and the AEC. Engineering, construction, and peak construction manhours are calculated per kW(e). Information on material placement of piping, electrical cable, electrical conduit, terminations, concrete, and reinforcing steel for one-, two-, and three-unit BWR and PWR plants is supplied. Material for a 1100-MW(e) reactor and material placement rates are discussed. Projected lead times are presented. (MCW)

17984 SWITZERLAND AND NUCLEAR ENERGY IN THE YEAR 1972. Schweiz. Bauztg.; 91: No. 38, 930-932(20 Sep 1973). (In German).

A public discussion of nuclear energy and the topics of future and existing nuclear power stations and their operation, import of current from abroad, radioactive waste, and the nuclear technological industry are briefly presented. (INIS)

17985 PRESENT AND FUTURE OF NUCLEAR POWER GENERATION IN JAPAN. Shirasawa, T. (Japan Atomic Power Co., Tokyo). At. Jap.; 17: No. 5, suppl., 21-33(May 1973).

The development of nuclear power generation in Japan from 1955 to the present is reviewed. The present status and role of nuclear power in overall power generation, the nuclear power development program, and the stand taken by power utilities are discussed. The combined nuclear power plant production at present totals 1,823 MW(e), about 3% of the total production. As industrial activities increase in Japan, the importance of nuclear energy steadily rises, especially in view of the deepening energy crisis. According to the AEC's long range program set in 1972, worldwide nuclear energy production as of 1985 will be 60 million KW(e). In order to replace fossil-fuel power plants with nuclear plants, nuclear fuel supply problems must be dealt with, sites for nuclear plants must be acquired, and public confidence in nuclear safety must be established. (JA)

17986 NUCLEAR OPTIONS. Bainbridge, G. R. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nature (London); 249: No. 5459, 733-737(21 Jun 1974).

The nuclear fission reactor options which Britain could take up during the next decade are discussed and an outline is given of the broad energy requirements for which nuclear reactors are needed. (auth)

17987 NUCLEAR FISSION AS A GENERAL SOURCE OF ENERGY. Shepherd, L. R. (OECD, Winfrith, Eng.). Nature (London); 249: No. 5459, 717-720(21 Jun 1974).

The application of heat from nuclear reactors for several purposes other than the generation of electricity, for example as a source of heat for chemical processes or for producing "synthetic" fuels is discussed. (auth)

17988 NUCLEAR ENERGY IN THE U. S. ENERGY INDEPENDENCE PLAN. Com. Naz. Energ. Nucl., Notiz.; 20: No. 4, 89-93(Apr 1974). (In Italian).

A brief description of the President's plan for achievement of self-sufficiency in energy by 1980 is given, and the essential features of the fiscal 1975 budget are given. The measures adopted to facilitate construction of nuclear power plants and governmental debates on the energy program are discussed. (auth)

17989 NUCLEAR ENERGY IN INDIA. Casa, A. F.; Perilli, M. L.; Sansone, M. M. Com. Naz. Energ. Nucl., Notiz.; 20: No. 4, 75-88(Apr 1974). (In Italian).

Nuclear activities carried out in India since the late Forties, when the India Atomic Energy Commission was established, are reviewed. Particular emphasis is placed on nuclear power programs, which call for the construction of several nuclear power plants. Materials, fuels, and radioisotopes are discussed. India's uranium and thorium deposits, fuel fabrication and reprocessing facilities, and heavy water production plants are mentioned. The major research institutes described, and information on India's current plans for the peaceful use of nuclear explosions are summarized. (auth)

17990 NUCLEAR POWER: STATUS AT THE END OF 1973 DEVELOPMENT FORECASTS. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 20: No. 4, 55-74(Apr 1974). (In Italian).

A wide statistical study is made on the nuclear power plant evolution during the decade 1963-1973, with particular emphasis on the role of the major constructing firms and the different reactor types. An indication is given on the forecast of nuclear development up to the end of the century, placing this forecast in the global energetic view. (auth)

17991 STRATEGY OF ENERGY SOURCES AND RELATED RESEARCH AND DEVELOPMENT. Franco, G. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 20: No. 4, 25-45(Apr 1974). (In Italian).

The causes of the current energy crisis are reviewed, and data on the requirements and real consumption of energy in Italy and other countries are supplied. Nuclear energy is represented as one of the energy sources best suited to cope with the ever increasing world requirements, and its more widespread and efficient exploitation and utilization are recommended. In this context, the possibilities offered by energy centers, direct utilization of heat, and offshore nuclear power plants are reviewed. (auth)

Reactor Fuel Cycle Economics

Refer also to abstracts 15087, 17575, 17594, and 17953.

17992 PLANNING INCENTIVES FOR NUCLEAR FUEL CYCLE AND POWER SYSTEM OPTIMIZATION: REGIONAL VIEWPOINT. Tallman, R. J. (Bonneville Power Administration, Portland, OR); Grunne, L. L.; Holm, A. J.; Larkin, D. Trans. Amer. Nucl. Soc.; 18: 171(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17993 NUCLEAR UNIT REFUELING AND OPERATING STRATEGY OPTIMIZATION. Bonk, G. J.; Wicks, F. E. (General Electric Co., Schenectady, NY). Trans. Amer. Nucl. Soc.; 18: 172-174(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

17994 CALCULATION OF NUCLEAR INCREMENTAL FUEL COSTS FOR POWER SYSTEM OPTIMIZATION. Omberg, R. P.; Rothrock, R. B. (Westinghouse-Hanford Co., Richland, WA). Trans. Amer. Nucl. Soc.; 18: 175-176(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

Reactor Licensing and Regulation

Refer also to abstract 17561.

17995 (DOCKET-50016-228) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Report for the First Quarter of 1974. (Power Reactor Development Co., Detroit, Mich. (USA)). 1974. 17p. Dep. NTIS $4.00.

Information is presented on the reactor retirement plan including Na handling, Nak disposal, disposal of contaminated equipment and materials, sealing the primary Na system, retirement of auxiliary systems, post-retirement surveillance, and unusual incidents. Waste discharge, personnel exposures, liquid samples, Na activity, environmental surveys, maintenance, periodic test activities, and personnel changes are also reported. (FS)

17996 (DOCKET-50496-1) MONTAGUE NUCLEAR POWER STATION, UNITS 1 AND 2. License Application. (Northeast Nuclear Energy Co., Hartford, Conn. (USA)). 12 Jul 1974. 35p. (Docket-50497-1). Dep. NTIS $4.75.

Application for construction and operation of a two unit BWR nuclear power station is presented. The power plant will be located on a site in northern Massachusetts approximately 1.2 miles south southeast of Turners Falls. The containment will be a free-standing steel right cylinder with a torospherical dome and flat bottom. The rated core thermal power will be 3,579 MW(t) with a net electrical output of about 1,150 MW(e). The safety analysis core thermal power is 3,758 MW(t). The circulating water system for each unit provides the condenser with a supply of cooling water. The circulating water system is a pumped closed-loop system utilizing natural draft cooling towers as a heat sink. (FS)

17997 (DOCKET-STN-50495-1) STONE AND WEBSTER ENGINEERING CORPORATION PWR REFERENCE NUCLEAR POWER PLANT. Standard Safety Analysis Report, SWESSAR-P1, Volume 1. (Stone and Webster Engineering Corp., Boston, Mass. (USA)). 21 Jun 1974. 183p. Dep. NTIS $12.25.

SWESSAR-P1 supports an application for certification of a standard design of structures, systems, and equipment for a standard PWR type power plant with an initial core power of about 3800 MW(t) resulting in an electrical output of about 1350 MW(e). This standard design utilizes the designs provided by three vendors in their standard SARs. A utility applicant will submit a PSAR which references a vendor SAR and this SWESSAR and any supplementary information needed. Where differences in the vendors NSSS affect the design of structures, systems, and equipment, separate descriptions are identified for each vendor. Site related design criteria accommodate the majority of sites in the U. S. Review of the certified plant design will be unnecessary at the construction permit stage if the site selected falls within the site criteria established in this SWESSAR. (FS)

17998 (DOCKET-STN-50498-1) SOUTH TEXAS PROJECT, UNITS 1 AND 2. License Application. (Houston Lighting and Power Co., Tex. (USA)). 1 Jul 1974. 398p. (DOCKET-STN-50499-1). Dep. NTIS $23.00.

An application is presented for a license to construct and operate two PWR four-loop nuclear power reactors at a site in Matagorda County, Texas, west of the Colorado River, and about 89 miles southwest of Houston and nine miles northwest of the town of Matagorda. Each reactor will have an initial nuclear output of 3800 MW(t) and a design rating of 3817 MW(t) equivalent to 1312 MW(e). The containment structure is a post-tensioned concrete cylinder with a steel liner plate, hemispherical top and a flat bottom. A 7,000 acre cooling reservoir is provided. (FS)

17999 (FIND-50245-R1) FIND: MILLSTONE NUCLEAR POWER STATION, UNIT 1. Items 1-367 and Item 52. Horn, F. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Jun 1974. 22p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

18000 (FIND-50458) FIND: RIVER BEND STATION, UNITS 1 AND 2. Items 1-34. Carter, E. P. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). May 1974. 25p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DCC)

18001 FLOATING NUCLEAR POWER PLANTS: ENVIRONMENTAL ISSUES AND LICENSING. Thoma, R. E.; Siman-Tov, M.; Vanderploeg, H. A. (Oak Ridge National Lab., TN). Trans. Amer. Nucl. Soc.; 18: 57-58(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18002 ROLE OF ENVIRONMENTAL STATEMENTS IN PROMOTING INTERNALIZATION OF ENVIRONMENTAL COSTS AND AN EVALUATION OF THEIR BENEFIT-COSTS-ANALYSIS PRACTICES. Golay, M. W.; Anderson, L. R. (Massachusetts Inst. of Techn., Cambridge). Trans. Amer. Nucl. Soc.; 18: 59-60(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18003 LEGAL CONSIDERATIONS OF NUCLEAR PLANT STANDARDIZATION. Charnoff, G. (Shaw, Pittman, Potts and Trowbridge, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 237(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18004 IMPLEMENTATION OF THE STANDARDIZATION POLICY FOR NUCLEAR POWER PLANTS BY THE REGULATORY STAFF. Haass, W. P. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 237(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18005 REFERENCE-SYSTEM CONCEPT OF NUCLEAR PLANT STANDARDIZATION. Bjeldanes, M. N. (Northern States Power Co., Minneapolis); Swanson, A. E. Trans. Amer. Nucl. Soc.; 18: 238-239(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18006 NUCLEAR STANDARDS: GOALS VS ACCOMPLISHMENTS AS AEC-RS SEES IT. Minogue, R. B. (Atomic Energy Commission, Washington, DC). Trans. Amer. Nucl. Soc.; 18: 252(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18007 EXPERIENCE WITH GUIDES AND STANDARDS. Moore, J. S. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc.; 18: 252-253(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18008 VIABILITY OF NUCLEAR STANDARDS. Hinds, J.; Gilbert, W. D. (General Electric Co., San Jose, CA). Trans. Amer. Nucl. Soc.; 18: 254(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18009 RELATIONSHIP BETWEEN REGULATORY GUIDES AND INDUSTRY STANDARDS. Dobel, H. F. (Babcock and Wilcox Co., Lynchburg, VA). Trans. Amer. Nucl. Soc.; 18: 254-255(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18010 EXPERIENCE WITH GUIDES AND STANDARDS AS RELATED TO OPERATING QUALITY ASSURANCE. Lingafelter, J. W. (Nuclear Services Corp., Campbell, CA). Trans. Amer. Nucl. Soc.; 18: 255-256(Jun 1974).

From annual meeting of the American Nuclear Society; Philadelphia, PA (23 Jun 1974).

18011 ROLE OF THE ATOMIC SAFETY AND LICENSING BOARD PANEL. Goodrich, N. H. Nucl. Safety; 15: No. 4, 383-386(1974).

The function of the Atomic Safety and Licensing Board (ASLB) is to conduct hearings, as needed, pursuant to Sec. 191 of the Atomic Energy Act. Hearings are conducted in each instance by three-member boards appointed from the membership of the ASLB Panel, which was reconstituted for this sole purpose in November 1971. Prior to that time, Panel officials also were responsible for appellate review of hearing-board decisions. The appeal function is now conducted separately by boards appointed from an Atomic Safety and Licensing Appeal Panel, which operates independently of the ASLB Panel. (6 references) (auth)

18012 REVIEW OF THE FINAL ENVIRONMENTAL STATEMENT CONCERNING THE "AS LOW AS PRACTICABLE" HEARING. Snyder, W. S. Nucl. Safety; 15: No. 4, 440-443(1974).

18013 CONCLUDING STATEMENT OF THE AEC REGULATORY STAFF IN THE "AS LOW AS PRACTICABLE" HEARING. Nucl. Safety; 15: No. 4, 443-452(1974).

18014 NUCLEAR SAFETY IN FOREIGN COUNTRIES. Messiah, A. (Ministere du Developpement Industriel et Scientifique, Paris). Ann. Mines; No. 1, 87-94(Jan 1974). (In French).

In most countries the state represents both the promoter of nuclear energy and the body responsible for public safety and environmental protection. In the western world these two functions are separated. The authorization and control regimes for nuclear plants in the USA, Great Britain and Federal Germany are reviewed. (FR)

GENERAL

Civilian Defense

18015 (CONF-730588-, pp 110-116) INTERSTATE CIVIL DEFENSE AND DISASTER COMPACT APPLICABILITY IN THE EVENT OF RADIOLOGICAL INCIDENT. Zimmerman, F. L. (Disaster Project Council of State Governments, Washington, DC). [nd].

From proceedings of the 2nd annual legislative workshop; Oak Ridge, Tennessee, USA (16 May 1973).

In radioactive shipments through our states: the weakest link.

The need for enacting the Interstate Civil Defense and Disaster Compact in all states and specific articles in the Compact are discussed. (LCL)

Energy Utilization and Economics

18016 (COO-3429-19) HYDROGEN SOLUBILITY IN 1:5 COMPOUNDS BETWEEN Y OR Th AND Ni OR Co. Takeshita, T.; Wallace, W. E.; Craig, R. S. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1973. 9p. Dep. NTIS $4.00.

Pressure-composition isotherms for the RCo_5–H system are reported. For comparison purposes YNi_5, $ThCo_5$, and $ThNi_5$ were examined as possible solvents for hydrogen. YCo_5 and $ThCo_5$ absorb hydrogen gas reversibly giving the limiting composition ratio of hydrogen atom to compound, $N_H \approx 3.0$ in both cases. YNi_5 and $ThNi_5$ do not absorb hydrogen gas under the applied pressure of up to 150 atm. (LK)

18017 (COO-3429-20) SOLUBILITY OF H_2 IN RCo_3 COMPOUNDS. Takeshita, T.; Wallace, W. E.; Craig, R. S. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1973. 8p. Dep. NTIS $4.00.

RT_3 systems (R = Dy, Ho, or Er) were investigated in regard to their capability as hydrogen host lattices and their potential for hydrogen storage. The present study provided information on the maximum solubility of H_2 in the RCo_3 phases and pressure-composition-temperature data for RCo_3–H_2 systems. (LK)

18018 (EUR-5059) HYDROGEN PRODUCTION FROM WATER USING NUCLEAR HEAT. Progress Report No. 3 (Annual Report Ending December 1972). (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). 1974. 88p. Dep. NTIS (US Sales Only) $7.50. EUR B.Fr. 125.-.

Multistep chemical processes for the decomposition of water, using nuclear heat, are studied in view of producing hydrogen as intermediate energy vector. The results of the experimental work performed at the Ispra Establishment of the J.R.C. during the year 1972 are reported; the list of the sixteen cycles which have been already defined is indicated. The studies are principally related to the chemical reactions (equilibria and kinetics studies), to the physical property measurements, to the corrosion problems, to the preliminary flow-sheet determination; the block-diagrams calculations for two processes are reported. (auth)

18019 (LA-UR-74-724) CONDUCTOR TESTS FOR DC SUPERCONDUCTING POWER TRANSMISSION. Bartlett, R. J.; Hammel, E. F.; Hoffer, J. K.; Keller, W. E.; Kerr, E. C.; McDonald, T. E.; Taylor, R. D.; Trela, W. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 12p. (CONF-740509-6). Dep. NTIS $4.00.

From 5th international cryogenic engineering conference; Kyoto, Japan (7 May 1974).

The cryogenic and electrical aspects of a new program to evaluate superconductors suitable for a dc superconducting power transmission line are presented. Short sample tests at 4°K at currents up to 39 kA and test bed operation up to 10 kA are described. (auth)

18020 (LA-UR-74-918) ENERGY STORAGE FOR THE ELECTRIC POWER INDUSTRY. Keller, W. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. 10p. (CONF-740641-1). Dep. NTIS $4.00.

From conference on advanced energy systems; Denver, Colorado, USA (20 Jun 1974).

The following energy storage systems for leveling the energy demands from power companies are briefly discussed: (1) pumped hydrostorage, (2) compressed air storage, (3) secondary batteries, (4) liquid hydrogen storage, and (5) flywheels. Superconducting magnetic energy storage systems are also discussed. (MOW)

18021 (LA-UR-74-984) PROCESS ENVIRONMENT EFFECTS ON HEAT PIPES FOR FLUID-BED GASIFICATION OF COAL. Strimbeck, D. C.; Sherren, D. C.; Keddy, E. S. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 20p. (CONF-740805-1). Dep. NTIS $4.00.

From 9th Intersociety Energy Conversion Engineering Conference; San Francisco, California, USA (26 Aug 1974).

The Bureau of Mines is evaluating sodium-type heat pipes for the isothermal transport of heat at 2,000°F from a fluid-bed coal-air combustor to a fluid-bed coal-steam gasifier. Tests were conducted to determine the physical and chemical effects of combustion-gasification atmospheres on Inconel 601 pipe. A prototype pipe exposed to such an environment for 522 hours functioned acceptably and remains operable. Tests with this pipe and five pipes of the same design are continuing. Results of initial tests of the six pipes are presented and the pipes and gasification concept are described. (auth)

18022 (SAND-74-8604) PROSPECTS FOR SOLAR ENERGY UTILIZATION. Brumleve, T. D. (Sandia Labs., Livermore, Calif. (USA)). Jun 1974. Contract AT(29-1)-789. 11p. (CONF-740639-1). Dep. NTIS $4.00.

From annual conference of the California Society of Professional Engineers; Stateline, Nevada, USA (13 Jun 1974).

A brief overview of the present status and the prospects for various potential applications of solar energy is presented. A few general observations regarding the nature and utilization of solar energy are offered. Main emphasis is on the direct use of solar radiation in heat engines. (WDM)

18023 (SLA-74-281) SOLAR ENERGY: SANDIA'S PHOTOVOLTAIC RESEARCH PROGRAM. Samara, G. A.; Schueler, D. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). May 1974. Contract AT(29-1)-789. 14p. Dep. NTIS $4.00.

A brief description is given of Sandia Laboratories on-going and planned activities in photovoltaic solar energy conversion. The scope of the program, its overall objectives and expected accomplishments are outlined. (auth)

18024 THE CONCEPT OF YIELD IN APPLICATION OF NUCLEAR ENERGY FOR PRODUCTION OF ELECTRICITY. Brand, P. (Keuring van Electrotechnische Materialen N. V., Arnhem (Netherlands)). Ingenieur (The Hague); 86: No. 13, 250-252(28 Mar 1974). (In Dutch).

Estimates are given of world uranium resources, both surveyed and possible, divided between those available at a cost of $10 USA/pound of U_3O_8 and those where the cost would lie between $10 and $15. The percentage yield increases rapidly with nuclear conversion factor in the region on unity conversion factor, and the sodium-cooled fast breeder has the greatest efficiency yet obtained. Gas-cooled fast breeders in development may reach this same figure of approximately 80% for the nuclear yield. The overall thermal yield of reactors in current use is from 30 to 40%, and use of gas-turbines in a closed helium cycle is expected to lead to yields of 50%. Reactors using the thorium cycle increase the potential available nuclear fuel. (auth)

Information Handling

18025 (IS-3383) DESIGN AND SUGGESTIONS FOR IMPLEMENTATION OF AN ON-GOING RETROSPECTIVE RETRIEVAL SYSTEM. Jordan, J. R.; Sun, R. P.; Maple, C. G. (Ames Lab., Iowa (USA)). Jun 1974. Contract W-7405-eng-82. 18p. Dep. NTIS $4.00.

The design and file structures of a retrospective document retrieval information system are described. The structure involves inverted files of index terms with document numbers recorded for each term. Files become very large, and the techniques of updating are emphasized. (SFL)

18026 (KFK-1929) CONSIDERATIONS FOR AN EUROPEAN CENTRALIZED RELIABILITY DATA BANK SYSTEM. Caldarola, L. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Oct 1973. 17p. (CONF-731075-1; EUR-4972). Dep. NTIS (US Sales Only) $4.00.

From international seminar on reliability data banks; Stockholm, Sweden (15 Oct 1973).

Today's reliability data banks are still unsatisfactory. The disadvantages of these banks are briefly analyzed; and it is concluded that future banks may improve the quality of their services if they are more specialized and connected through a centralized system. In this way it should be possible to satisfy the more severe reliability requirements which are continuously requested for technological applications in highly reliable systems, such as energy systems, transportation systems, and the computer industry. This can be obtained by a high degree of knowledge of the device's properties based on past experience. In order to acquire this high degree of knowledge, the knowledge of the manufacturer and that of the user must merge together through an integrated learning

process. This process requires the complete exchange of information between the manufacturer of a given device and the user. In the case of replaceable devices, new (not yet used) devices will be tested only initially in order to provide sufficient knowledge to render the devices operational. Later, since the preventative maintenance policy will be currently adopted, lifetests will be carried out preferably on used devices, which were dismissed before failure after having been used for the allowed length of time. It turns out that the learning process takes in this case the form of a cycle. The cycle begins when a new device starts operation in the user's plant, and it ends when the information gained from the lifetests, carried out in the laboratory on the same device (now called "used device"), reaches the user through the "bank." Information will be produced continuously, and the speed of learning will be a function of the flow of devices in the cycle, that is, to the ratio between the number of devices present in the cycle and their residence time in the cycle. Various strategies of learning are therefore possible, and some of them are also discussed. Finally, the motivations are analyzed for establishing a centralized system, and the associated problems discussed. (3 figures) (auth)

18027 (LBL-3007) SYSTEM OF INFORMATION RETRIEVAL AND ANALYSIS FOR PLANNERS (SIRAP). Gey, F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1974. Contract W-7405-eng-48. 9p. (CONF-740539-1). Dep. NTIS $4.00.

From northwest CIPS-ACM regional symposium; Vancouver, B.C., Canada (23 May 1974).

SIRAP is a system of information retrieval and analysis for government planners. SIRAP consists of three entities: the information retrieval facility, the data analysis facility and the teletype facility. All data files within SIRAP are fixed statistical, economic, environmental, and demographic data obtained from U.S. Government agencies such as the Bureau of Census, Economic Development Agency, Bureau of Labor Statistics, and the U. S. Army Corps of Engineers. Most SIRAP files are designed to be uniformly retrievable using the QWICK QWERY retrieval program (a proprietary product of Consolidated Analysis Centers, Inc.). Some large files (such as the 1970 U.S. Census of Population) have their own random access retrieval system coupled with fixed format computer reports. (auth)

18028 (NP-20056) PUBLICATIONS OF THE JUNTA DE ENERGIA NUCLEAR. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 170p. (In several languages). Dep. NTIS (US Sales Only) $11.50.

Law

Refer also to abstracts 15882 and 18002.

Management

Refer also to abstract 15868.

18029 (DHEW-74-8004) REPORT OF STATE AND LOCAL RADIOLOGICAL HEALTH PROGRAMS: FISCAL YEAR 1972. Miller, L. A. (Bureau of Radiological Health, Rockville, Md. (USA)). Aug 1973. 90p. (PB-228716). GPO $1.10.

This report is the twelfth of a series based on data collected during fiscal year reviews of 53 US state and local radiological health programs. The resources and activities of state and local radiological health programs are presented and summarized from data collected as of June 30, 1972. Summary data are included for fiscal years 1967 through 1972. Resources surveyed include data on personnel, funds, and equipment. The program activity areas are basic planning and administration, diagnostic x-ray survey and control, environmental surveillance, radioactive materials, electronic products, and other radiological health activities. (auth)

18030 (FDA-74-8014) STATUS AND FUTURE MANPOWER NEEDS OF PHYSICISTS IN MEDICINE IN THE UNITED STATES. (Bureau of Radiological Health, Rockville, Md. (USA)). Nov 1973. 61p.

The primary purpose of this study was to provide a basis for describing the job responsibilities of medical physicists in the radiological health sciences. An estimate is included of the manpower needs for physicists and the influence of these needs on medical physics training programs. (auth)

18031 (JAERI-5011(Vol. 7)) TECHNICAL PUBLICATIONS BY JAERI STAFF, JANUARY 1973–DECEMBER 1973. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 43p. Dep. NTIS (U. S. Sales Only) $5.25.

Approximately 340 journal articles, papers at meetings, reports, and books which were published by personnel of JAERI from January 1973 to December 1973 are listed. The contents for each entry include the title, language in which it is written, author(s), and journal name or origin. They are presented in INIS subject categories. The indexes are both by authors and report number. A list of the patents originating at JAERI, including both Japanese and other patents, is also given. (auth)

18032 (STI/DOC-10-154) IAEA RESEARCH CONTRACTS. Fourteenth Annual Report. (International Atomic Energy Agency, Vienna (Austria)). Apr 1974. 184p. IAEA $9.00.

Brief summaries of research programs sponsored by IAEA during 1973 are given. Programs are reported in the following subject areas: nuclear power reactors, waste management, physics, chemistry, agriculture, food technology, radiation and radioisotope applications, medicine, dosimetry, hydrology, radiobiology, radiological safety, and nuclear materials safeguards. (SFL)

18033 CROSSROADS OR TIGHTROPE: THE FUTURE OF MEDICAL PHYSICS. Lenihan, J. M. A. (Western Regional Hospital Board, Glasgow). pp 657-661 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The future of radiological physics as it relates to the medical profession in Israel is discussed. The increasing role of the physicist in the medical profession is mentioned. (ERB)

18034 ROLE OF CLINICAL RADIOPHYSICS IN RADIOLOGY. Larsson, L. E. (National Inst. of Radiation Protection, Stockholm). pp 662-664 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

The role of clinical radiophysics in radiology and nuclear medicine is discussed particularly as it relates to development of the discipline in Israel. (ERB)

18035 MEDICAL PHYSICS IN ISRAEL: AN EXTERNAL ASSESSMENT. Cohen, M. (London Hospital). pp 665-684 of Proceedings of the Regional Conference on Radiation Protection. Vol. 2. Feige, Y. (ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).

From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P2.

A review is presented of the present state and future prospects of Medical Physics in Israel, based on the author's Assignment Report of a month spent in Israel (September, 1971) on behalf of the World Health Organization. At present (March, 1973) there are 6 full-time physicists working in Israeli hospitals. It is suggested that this number should be increased to 50 to 60 within a decade, including 9 to 14 physicists in radiotherapy, about 15 in nuclear medicine, the remainder in other branches of medical physics and bioengineering. The development of three major independent departments of medical physics and bioengineering with university status is advocated, to serve the whole country on a regional basis. (auth)

18036 INTERACTION BETWEEN GOVERNMENT AND INDUSTRY: LESSONS FROM HARWELL'S EXPERIENCE. Marshall, W. Atom (London); No. 210, 75-81(Apr 1974).

From lecture presented to the National Academy of Sciences; Washington, DC (Oct 1973).

Changes in the research program of the Atomic Energy Research Establishment, Harwell, that have taken place in recent years are described, and some tentative conclusions are drawn that might be applicable to other large national laboratories. Early differences between the work at Harwell and USAEC laboratories are briefly mentioned, and the division of work on the nuclear power program between Harwell and the remainder of the UKAEA and industry is mentioned. This is followed by a review of the introduction of non-nuclear research and innovation in collaboration with industry, with the results of this introduction, including economic benefits to Harwell. The successful and growing interaction with British industry is now being cautiously expanded to overseas industry. It was discovered that the knowledge of industry attained also made Harwell more helpful to Government Departments in a number of ways and able to win contracts from such Departments. All of this has led to about half of the present staff being devoted to new programs that did not exist several years ago. It is emphasized, however, that a national laboratory such as Harwell must be careful never to act to the national disadvantage and this inevitably must imply some restrictions on commercial freedom. Some examples of work being done in the non-nuclear field are listed. (UK)

18037 ACTIVITIES OF THE IAEA RELATED TO ENVIRONMENTAL PROTECTION. Nishiwaki, Y. (International Atomic Energy Agency, Vienna). pp 279-284 of Proceedings of the Regional Conference on Radiation Protection. Vol. 1. Feige,

Y. (Ed.). Yavne, Israel; Soreq Nuclear Research Centre (1973).
From regional conference on radiation protection; Jerusalem, Israel (5 Mar 1973). See CONF-730345-P1.

Activities of the International Atomic Energy Agency related to the field of environmental protection against radiations are briefly reviewed. Activities include educational programs, research support programs, and recommendations concerning occupational health and safety standards for radiation. (CH)

Mathematics and Computers

18038 (ANL-8097) GSPEAK: A DATA MANAGEMENT FACILITY FOR SPEAKEASY. Cohen, S.; Gloeckner, D. H. (Argonne National Lab., Ill. (USA)). May 1974. Contract W-31-109-eng-38. 22p. Dep. NTIS $4.00.

A method for convenient, long-term storage of large amounts of information is described. By using this technique, data generated during execution of Speakeasy or other Fortran programs can be cataloged and saved for retrieval and use at a later time. This storage technique is specifically oriented toward management of a large number of blocks of data that can be addressed through a structured classification. As an example, access and manipulation of results generated by the Argonne Nuclear Shell-Model System is shown. An example of the use of the storage technique for extended calculations in Speakeasy is also given. (auth)

18039 (BDX-613-1138) AUTOMATED TESTING IN A HIGH NOISE ENVIRONMENT. Taylor, R. D. (Bendix Corp., Kansas City, Mo. (USA)). [nd]. 15p. (CONF-740533-2). Dep. NTIS $4.00.

From spring DECUS symposium; Boston, Massachusetts, USA (29 May 1974).

18040 (BNL-18260) UNIFIED APPROACH TO DIGITAL SIMULATION, DESIGN AUTOMATION, AND LOGIC SYNTHESIS. Peskin, A. M. (Brookhaven National Lab., Upton, N. Y. (USA)). 19 Sep 1973. 28p. (CONF-740802-3). Dep. NTIS $4.50.

From 6th congress of the international federation for information processing and exhibition; Stockholm, Sweden (5 Aug 1974).

18041 (CEA-R-4588) ANALYSIS AND SYNTHESIS OF A LOGIC CONTROL CIRCUIT BY BINARY ANALYSIS METHODS. Chicheportiche, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jun 1974. 95p. (In French). Dep. NTIS (US Sales Only) $7.75.

18042 (CERN-74-10) PRECONDITIONING AND CONVERGENCE ACCELERATION IN SPARSE MATRIX PROBLEMS. Axelsson, O. (European Organization for Nuclear Research, Geneva (Switzerland)). 8 May 1974. 30p. Dep. NTIS (US Sales Only) $4.50.

18043 (COO-2118-50) FINAL REPORT. Robertson, J. E. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Jun 1974. Contract AT(11-1)-2118. 13p. (UIUCDCS-R-74-656). Dep. NTIS $4.00.

18044 (EUR-4967) REAL TIME OPERATING SYSTEM FOR SMART DATA TERMINALS. Eder, J.; Hammans, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). May 1974. 46p. Dep. NTIS (US Sales Only) $5.50. EUR B.Fr. 60.-.

18045 (IS-3397) ALGORITHMS FOR PROJECTION METHODS FOR SOLVING LINEAR SYSTEMS OF EQUATIONS. Wainwright, R. L.; Keller, R. F. (Ames Lab., Iowa (USA)). May 1974. Contract W-7405-eng-82. 144p. Dep. NTIS $5.45.

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